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RHINOPLASTIC APPROACH FOR DERMOID CYSTS OF THE NASAL DORSUM.

Report of Three Cases.*

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Reports of midline dermoid cysts of the nasal dorsum have appeared sporadically in the American literature since Birkett's report¹ in 1901. Although the condition is not considered rare, fewer than 75 cases have been reported. The lesion is generally agreed to be congenital, and its development is explained on an embryologic basis.²⁻⁴

The purpose of this paper is to present the cases of three patients with dermoid cysts of the nasal dorsum, on whom I have operated, and to discuss rhinoplastic procedures that may be helpful in such cases. Previously described approaches to this problem include midline incisions,³⁻⁹ horizontal incisions,^{4,10} elliptical incisions,⁴ an incision along the side of the nose between the inner canthus and upper part of the nasal dorsum,¹¹ external incisions (no other description)^{12,13} external incisions, plus opening of the cyst into the nasal cavity,¹¹ external incision plus bilateral osteotomy,^{4,11} and intercartilaginous incision plus septal operation.¹⁴

As far as I have been able to determine, there has been only one case reported in the American literature in which

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operation was not performed through an external incision over and along the side of the external nasal pyramid.¹⁴ Naturally, any case in which there is an opening, or sinus, along the midline will require an external incision to remove this area.

Most of the reported cases have been from four large clinics,^{4,10-12} and more than one-half on the patients were operated upon by surgeons of another specialty. The midline incision seems to be the most favored by the oto-rhino-laryngologist. Approximately 30 per cent of the patients had had previous surgical treatment (including incision and drainage).

All authors agree that the entire cyst must be removed. In the most recent article of Crawford and associates¹⁰ total surgical removal is considered much more satisfactory than curettage, chemicals or the electric cautery, as have been used by some in the past. They also believed that an attempt should be made to repair any defect present; however, later repair may also be necessary.

REPORT OF CASES.

Case 1. A white girl, aged two years, had had a lump on her nose for the preceding six months. Occasionally, some drainage was noted near the tip of the nose. The child's maternal aunt has a small "swelling" between the inner canthus and the nasion.

On examination a rounded, semi-fluctuant mass, measuring 4 x 4 mm., was noted over the nasal dorsum (see Fig. 1-A). It involved most of the bony vault and upper part of the cartilaginous vault. At the tip of the nose, in the midline, was a small depression containing a hair that was perpendicular to the skin. Slight pressure over the mass caused cheesy material to escape from the opening in the tip. From palpation the impression was gained that the nasal bones were separated up to the frontal spine, and that much less bone was present than is normal for a child of two years. On pediatric examination no other abnormalities or surgical contraindications were detected.

On June 6, 1953, after induction of endotracheal anesthesia, a midline incision was made. This was used because of the possible extension of the tumor and the smallness of the nose. The mass above was exposed; it lay between the nasal bones and upper third of the upper lateral cartilages, and extended about 3 mm. into the septum. Below the cyst a stalk was followed to the tip, where its opening to the outside was excised. Another tract extended from the main body of the cyst upward and backward beneath the frontal spine to the region of the cribriform plate. To be able to follow and visualize this tract some of the medial border of each remaining nasal bone had to be removed (this was saved to use in repair later). The nasal cavities were not entered at any time, although the septal mucosa was reflected about 3 mm. on each side to provide

more space. After removal of the cyst the nasal cavities were loosely packed to reposition the septal mucosa. Pieces of autogenous nasal bone and bovine cartilage were used to help repair the defect. The tissues were closed in layers and an adhesive dressing was put on the nose.

On microscopic examination of a section of the cyst (see Fig. 2), a cyst wall lined with stratified squamous epithelium was seen surrounding a slit-like space containing desquamated squamous cells. Hair follicles and sebaceous and sweat glands were present in the cyst wall. At one level a foreign body inflammatory reaction had developed in an environment showing a number of sebaceous glands and hair follicles. The microscopic diagnosis was dermoid cyst.

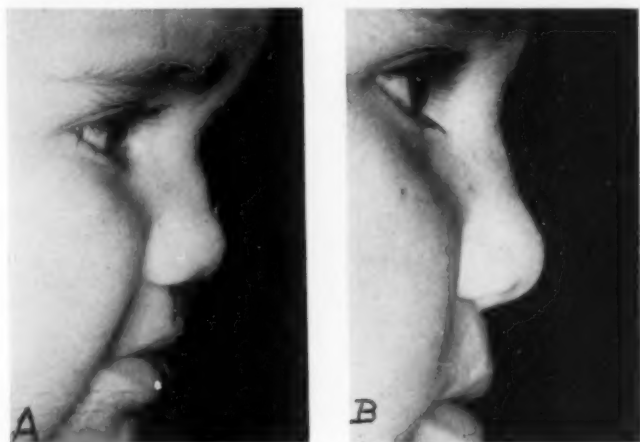


FIG. 1. Case 1. A.—Note swelling over upper part of dorsum (1953); B.—Five months after second operation (1957).

Comment. After almost five years there is no evidence of recurrence of the cyst; however, the bovine cartilage became partly absorbed and was movable. On June 16, 1957, intercartilaginous incisions were made, and the subcutaneous tissues were separated from the nasal framework. The remainder of the bovine graft was removed, the bony parts were "freshened up," and multiple pieces of despeciated bone were inserted. Fig. 1-B, shows the patient five months after this operation.

At this writing, seven months after the second operation, there seems to be no absorption of the inserted material. In

such a case some substance has to be used to correct the defect. Autogenous cancellous bone in the past has given the best results, but in such a young child, of course, it cannot be obtained. If the grafts that were inserted become absorbed, some kind of graft will have to be employed, not only to relieve the deformity but also to help keep the soft



Fig. 2. Case 1. Photomicrograph of dermoid cyst showing a cyst wall lined with stratified squamous epithelium surrounding a slit-like space containing desquamated squamous cells. Hair follicles and sebaceous and sweat glands are present in the cyst wall (X-20, H. & E.).

tissues stretched so that eventually, if necessary, autogenous cancellous bone can be used.

Case 2. A white girl, five-and-a-half years old, had had drainage from the tip of the nose since birth. During the preceding year this area had bled on several occasions after injury. The child had always been nervous and restless while sleeping.

On examination, at the tip of the nose in the midline was noted a small depression that contained hair perpendicular to the skin (see Fig. 3-A). With gentle pressure over the cartilaginous dorsum a thick cheesy material exuded. On palpation the impression was gained that the cartilaginous dorsum was soft in the midline and that the caudal ends of the nasal bones were separated medially more than is normal. Intranasal examination showed what was thought to be some thickness of the septum along both sides opposite the upper lateral cartilages.

Waters' and lateral roentgenograms of the skull and facial bones were made. A fairly well defined radiolucent shadow in the nasal bone was seen only in the lateral views.

On April 25, 1955, after induction of endotracheal anesthesia, incisions were made along the caudal margins of each lobular cartilage, extending medialward into the anterior portion of the columella. After both lateral and medial crura were uncovered, the soft tissues over the dorsum and along the side of the nose were undermined up to the nasion. The space in which to work was limited because of the small nose. It was, therefore, considered necessary to make an incision through the columella at its anterior extremity. After mobilization of this area excellent exposure was provided to the whole dorsum of the nasal framework. The cyst was



Fig. 3. Case 2. A.—Preoperative view showing small pit opening at tip. B.—Photograph two-and-one-half years postoperatively.

separating the upper part of the upper lateral cartilages extending upward beneath the nasal bones and had caused some separation of their caudal ends. It also extended along the dorsum of the bony and cartilaginous septum, and this caused the thickening noted on intranasal examination. As dissection was carried out around the cyst, it was necessary to remove part of the mesiocaudal margin of each nasal bone to afford working space. The upper extremity extended to the posterior cephalic region of the nasal bones. A small elliptical incision was made around the opening in the tip to remove the external opening of the caudal tract. This was closed with nylon sutures. The bony defect was filled with the removed bone and some isogenous cartilage. The incision in the columella was sutured with nylon. A small amount of packing was placed in both nasal cavities and vestibules, and an adhesive dressing was applied over the whole nose.

On microscopic examination of sections of the removed cyst, fibrofatty tissue was seen, containing an irregular cystic space lined with stratified

squamous epithelium, around which were rudimentary sebaceous glands and hair follicles containing hair shafts. Several shafts were within the lumen of the cyst. Adjacent to the cyst in one section was a foreign body reaction about hair shafts, due apparently to rupture of the cyst at one point not disclosed in these sections. The microscopic diagnosis was dermoid cyst (see Fig. 4).

Comment. In this case the described approach was adequate, and no deformity has resulted after three years. One

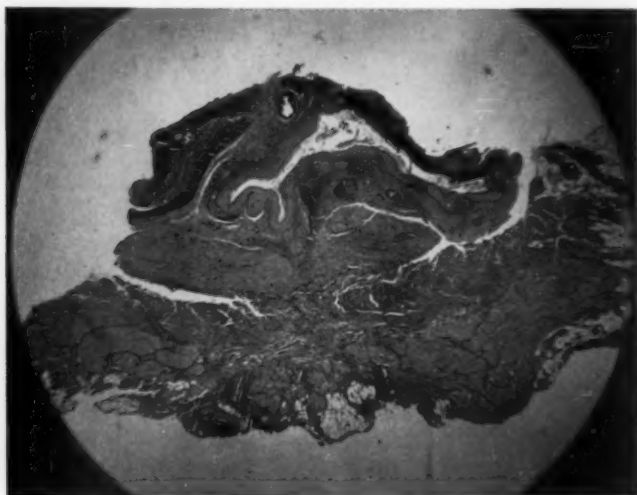


Fig. 4. Photomicrograph of dermoid cyst in Case 2 showing fibrofatty tissue containing an irregular cystic space lined with stratified squamous epithelium around which are rudimentary sebaceous glands and hair follicles containing hair shafts (X-20, H. & E.).

week after the initial dressing the child's family reported that she was not so nervous as before operation, that she was breathing well through her nose for the first time in her life, and that she was able to sleep without making noises, having nightmares and pulling off the cover. During the ensuing three years this result has persisted. The parents also admit that they, too, have been somewhat rehabilitated, owing to what they call having a normal child.

Case 3. A white man, 29 years of age, had had a "deformity" on the

bridge of his nose since birth, and at least one hair was always present. At times it became infected and drained what was thought to be pus.

On examination a somewhat punched-out area measuring 3 x 3 mm. was seen on the nasal dorsum at the level of the caudal end of the nasal bones in the midline. A few hairs were protruding (see Fig. 5-A); no discharge could be expressed. There was no external evidence of pathologic alterations below or above this area. Intranasally, the septum was deviated in its bony portion bilaterally.

In lateral roentgenograms of the nose there was evidence of a radiolucent area about 0.5 cm. wide, extending from the anterior tip of the nasal bones posteriorly for about 2 cm., where it was obscured by the overlying



Fig. 5. Case 3. A.—Preoperative photograph shows hairs in the depression. B.—Photograph twenty-three months postoperatively.

bones of the skull. In the postero-anterior view were noted deviation and definite widening of the nasal septum in its antero-superior portion, where again there was a faint radiolucent area. There was no evidence of destruction of bone. The changes were suggestive of a lesion in the antero-superior portion of the nose, causing some erosion of the nasal bones and occupying and causing some widening of the septum anteriorly. Iodized oil (Iodochoral®) was injected into the "sinus tract", and another roentgenogram was made (see Fig. 6). The tract extended from the opening in the anterior portion of the nose posteriorly for about 4 cm., where it was blocked apparently by a soft tissue mass.

On Feb. 22, 1956, with use of a local anesthetic the septum was opened through a left hemi-transfixion incision, and the left septal mucosa was elevated back to the bony deviation. The cartilaginous septum was separated from the bony septum, and the mucosa over the right and left bony septum was elevated. A bulging of the bony septum, previously described as a deviation, was opened and found to contain a cystic mass. This

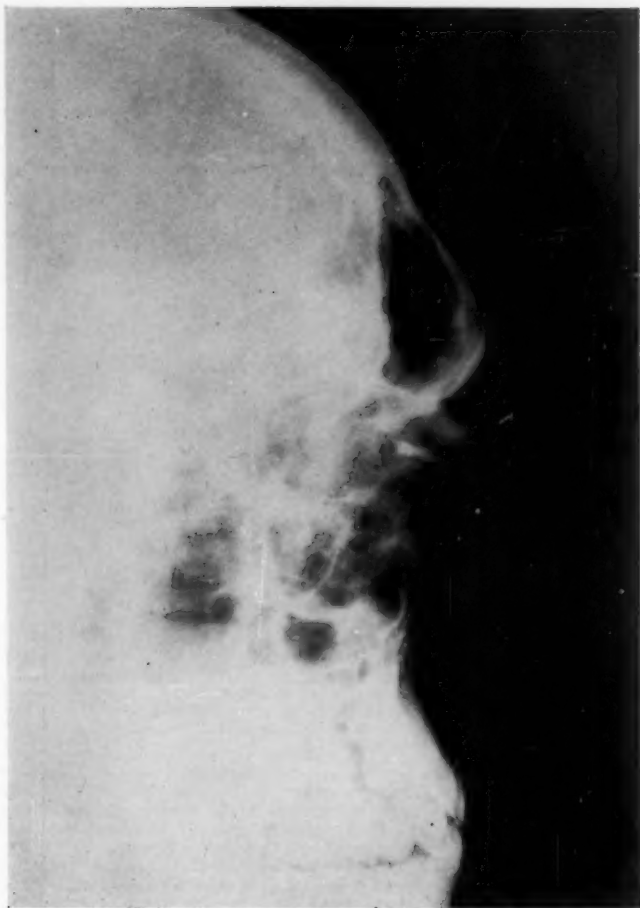


Fig. 6. Roentgenogram made after injection of iodized oil. The posterior extension is not visualized because the contents of the cyst obstructed its flow.

narrowed as it was uncovered posteriorly and extended almost to the face of the sphenoid (see Fig. 7). The cyst uncovered in the bony septum was opened and contained a cheesy material. An elliptical incision was made around the external opening, and the soft tissues were undermined. The stalk was dissected down between nasal bones and upper lateral cartilages and then followed into the exposed area in the septal space. All attachments were severed and it was removed. To correct the deformity between the nasal bones and also to help narrow an abnormally wide bony vault bilateral osteotomy and infrafracture were performed. Bone was replaced between the septal flaps, and the incision in the septum

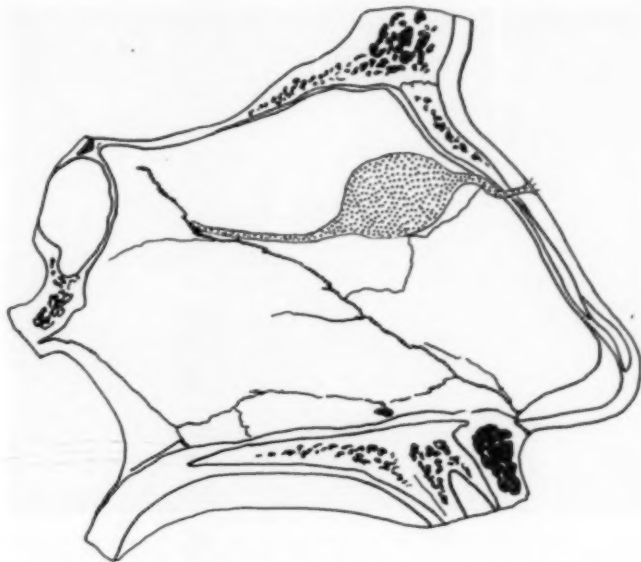


Fig. 7. Diagram of extension of cyst in Case 3.

was closed. The external incision was closed in layers after some autogenous bone and septal cartilage had been placed over the dorsum. Adhesive and stent dressing was applied.

On microscopic examination of sections of the removed specimen a channel, or cavity, lined with stratified squamous epithelium containing epithelial debris, and blood was seen (see Fig. 8). In the wall surrounding the cyst numerous hair follicles and sebaceous and sweat glands were present. The microscopic diagnosis was dermoid cyst.

Comment. All of the cyst was removed through the septal exposure except, of course, the external portion. Two other cases of cysts of the septum^{11,14} have been reported, but they

were both located in the septal cartilage; also in the cases reviewed only two osteotomies^{4,11} had been performed and they were not associated with the septal cases.

At this writing, practically two years postoperatively, there is no evidence of recurrence of the cyst. A serious psychologic problem has become greatly improved.

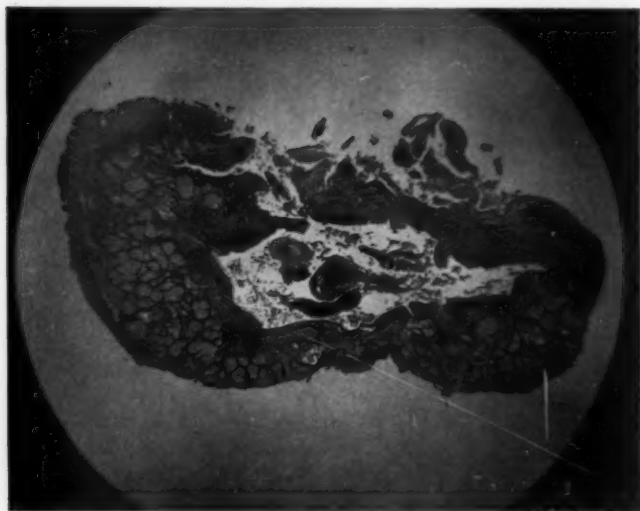


Fig. 8. Photomicrograph of dermoid cyst in Case 3 showing a cavity lined with stratified squamous epithelium containing epithelial debris and blood. In the wall surrounding the cyst numerous hair follicles and sebaceous and sweat glands are present (X-20, H. & E.)

DISCUSSION.

No routine operative procedure can be employed in these cases because the pathologic process varies. Even though the incision over the nasal dorsum does not cause a bad deformity, there is a scar. In patients who have only the small "pit opening" at the tip, and those who have a mass along the junction of the upper lateral cartilages and the nasal bones, the possibility of using a rhinoplastic procedure is real. Naturally the procedure used depends upon the diagnosis and

pathologic alterations found. Intercartilaginous incisions will provide good exposure up to and including the frontal spine. One may also remove a mid-dorsal cyst and inspect the area posterior to the nasal bones and frontal spine if the cyst extends into this area. It is also possible to go down into the nasal septum through the upper lateral cartilages and combine this procedure with a septum operation for complete removal of a cyst. This was part of the procedure described by Juers,¹⁴ and was used in Case 3 herein reported.

If the stalk comes down to the tip, another approach is possibly better. Incisions may be made along the caudal margins of both lobular cartilages (the slot incision described by Cottle¹⁵) extending down along the columella. The tissues external to the cartilage are uncovered, and the surgeon, continuing upward, may uncover the whole pyramid. By adequate and careful dissection the pathologic alterations can be visualized and removed providing the nose is not too small. In an extremely small nose, to obtain more working space, the columella can be severed at its anterior extremity, as was done in Case 2; this leaves only a minimal scar.

Another helpful procedure is osteotomy. Its use has been reported previously in two cases.^{4,6} This helps, in that the bony dorsum may be narrowed; it also helps to correct a deformity after part of the bone has been removed and helps insure formation of a good roof over the bony vault.¹⁶ This procedure was used in Case 3.

A secondary operation to correct a deformity created by the cyst and its removal is essential in some cases.¹⁰ Here again rhinoplastic procedures are invaluable, since most of these probably require attention to the bony dorsum. This area is easily reached through the intercartilaginous incisions. Such a procedure was used in a secondary operation in Case 1, in which the remainder of an old graft was removed, and some other grafts were reinserted. It is also possible to work in this area through the slot incisions should additional procedures need to be performed on the cartilages of the lobule.

SUMMARY.

Three cases of midline dermoid cysts of the nasal dorsum have been presented. Attention is called to the feasibility of using rhinoplastic procedures in applicable cases with the idea of leaving less visible postoperative defects.

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PERNASAL TRANSSPHEOIDAL YTTRIUM IMPLANT OF THE HYPOPHYSIS.*†‡

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In 1953, Luft and Olivecrona demonstrated the beneficial results that could be obtained with hypophysectomy in certain cases of advanced cancer. After much experience it now appears that only the hormone dependent cancers of the breast and prostate are likely to benefit.

As a result of the interest in hypophysectomy, numerous routes to the gland have been used, and methods of excision or destruction employed. The aim, of course, is to devise a simple operation which will cause minimal distress to the patient, as many of these coming to this type of surgery are severely debilitated; at the same time it is necessary to insure effective destruction or removal of the gland.

It is as well to recall some of the routes which have been used in the past to reach the hypophysis. Although the transcranial route was one of the first to be used, the mortality rate was so high that by the end of the first decade of this Century interest was being developed in the nasal routes; but even with the transseptal,² lateral rhinotomy,³ sublabial routes^{4,5,6} and their numerous modifications,^{7,8,6} the mortality rate in some series ran as high as 30 per cent. By the 1930's the great advance in neurosurgical techniques, and the need

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to remove totally, rather than partially, tumors involving this gland, the transcranial approach became once more the route of choice. With the advent of the sulphanamides and antibiotics the mortality rate of this procedure steadily declined. That this route was used by Luft and Olivecrona for excision of the gland in their pioneer work is not surprising.

The report of Forrest and Peebles Brown⁵ in 1955 renewed interest in the nasal route, and numerous modifications have been devised, but these routes are used mainly for the introduction of radioactive compounds rather than for surgical excision of the gland.

Regarding destruction of the gland, probably the greatest experience has been with surgical excision; however, an increasing number of cases are being subjected to procedures in which the gland is necrotized by implanting radioisotopes. External radiation methods, such as proton beam therapy, are at present in an experimental stage, and experience with them is very limited.

The method devised is based mainly on the work of two groups: one at the University of Chicago, the other at the University of Glasgow.

Rasmussen, Harper and Kennedy,¹¹ of the University of Chicago, in 1953 suggested that yttrium 90, a pure Beta emitter, if implanted in the form of multiple discrete beads, described by Kisilewski¹² in 1950, could effectively destroy the hypophysis. The transcranial route was used for placement of the beads, and in practice it has become obvious that even though the gland is under direct vision at the time of operation, accurate deposition of the beads is exceedingly difficult. Unfortunately, due to the very nature of the operation, it is difficult to obtain a field free of metal impedimenta and to position the patient's head, so that the use of continuous radiologic control is practical; furthermore, the operation is attended by the usual mortality rate, associated with such a neurosurgical procedure under general anesthetic.

Forrest¹³ and his associates, of the University of Glasgow, reported in 1956 their results obtained by implanting radon,

a source of Gamma rays, in the form of two tubes by the per-nasal transphenoidal route with the assistance of a complicated head holder and needle director. The procedure is controlled by intermittent radiography. Radon was used because Pattison and Swan¹⁴ in 1933 successfully treated a case of basophil adenoma of the pituitary by introducing two radon tubes into the sella tursica through the transcranial route. Forrest found that the Gamma irradiation required to destroy the pituitary also affected surrounding structures such as the optic nerves; therefore, yttrium 90 with its high activity over a short radius is now being used.

From the experimental work of Marinelli¹⁵ it was considered that complete destruction was more likely to follow the implant of multiple discrete sources, 1 mm. by 2 mm. of yttrium, rather than the two larger sources, 2 mm. by 6 mm., as used by Forrest; however, it was obvious that the nasal route held many advantages, the most important of which was the lower mortality rate, and adequate local anesthesia was considered sufficient to perform the nasal operation, a considerable advantage when dealing with these rather debilitated patients.

It was felt that only under direct vision could the needle be directed through the nose to the anterior wall of the sphenoid sinus without injuring the nasal mucosa, and that only with the assistance of image intensifiers (Müller Surgex units with Phillips intensifier tubes) could multiple yttrium beads be deposited with any degree of accuracy throughout the pituitary gland. The image intensifiers permit continuous fluoroscopic guidance throughout the procedure without exceeding the permissible exposure dose to the surgeon.

The method evolved is as follows: Under premedication of Nembutal 180 mgm., given two hours, and Demerol 100 mgm., given one hour before operation, the patient is brought to the operating room and very carefully positioned on the table with the occiput low in a modified Rose's position (see Fig. 1). The reason for this position is to allow the axial image intensifier to be brought into place. This positioning must be done with great care and gentleness in those patients with

spinal metastases, as any extreme degree of cervical extension will cause pain.

Local anesthesia is then induced with cocaine, 5 per cent, by instilling 0.5 cc. into each nostril with the head in three positions: first with the head turned to the left, then to the right and finally in the midline. Occasionally when the optimum position of the head and neck cannot be obtained the anesthesia is supplemented with a Sluder block (see Fig. 1).

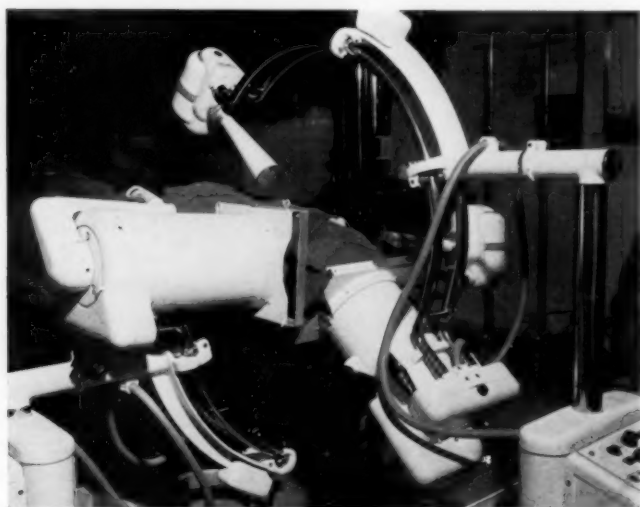


Fig. 1. The patient in position on the table with the neck and head extended. Image intensifiers are draped during operations.

At this stage the face is prepared and drapes applied. The two intensifiers are also draped and brought into position. The yttrium beads, 1 mm. by 2 mm., with an activity of approximately 1 mc., are then loaded into the cartridges under water. One cm. of water gives adequate shielding from the irradiation of these beads.

The strengthened 17 gauge needle (see Fig. 2) is then passed into the left nostril and guided under direct vision

to the anterior wall of the sphenoid sinus. Here the position of the tip and direction of the needle is checked by the intensifiers in both the axial and lateral views before the tip of the needle is advanced into the sphenoid sinus. Into the sinus is instilled 1.5 cc. of a penicillin topical thrombin solution, each cc. of which contains 10,000 U of penicillin and 200 U of thrombin. Under continuous guidance the needle

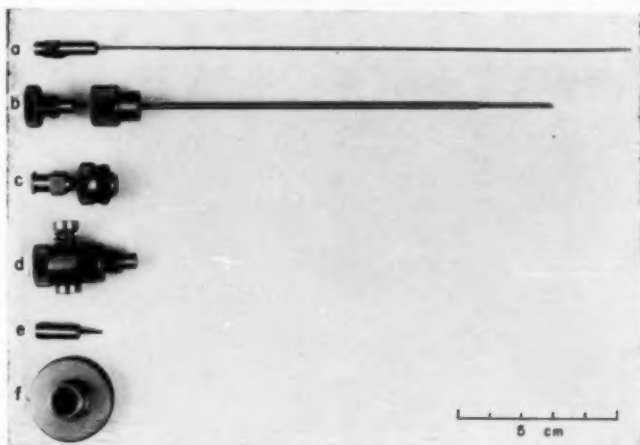


Fig. 2. Special instruments for introducing yttrium beads. a. Stilette which passes through cartridge (c) and cannula (b); b. trocar and cannula (17 gauge); c. adapter for connecting syringe to cannula (b) during installation of penicillin thrombin solution; d. cartridge, when mounted on stand (f) bead dropped into left end and pushed home with cartridge pin (e) while spring on transverse cylinder is compressed; on releasing spring bead is trapped in cylinder; quartz window permits observation of bead on its way through cartridge when stilette (a) is introduced; e. cartridge pin; f. stand for cartridge during loading.

is advanced into the medial portion of the left half of the pituitary. A posterior bead is deposited before withdrawing the tip a few mm. and depositing an anterior bead. The tip of the needle is then withdrawn into the sphenoid sinus and the needle angled laterally before being advanced once more into the gland. Again a posterior and an anterior bead are deposited, and this time in the lateral portion of the left half of the gland. Similar maneuvers are carried out on the right side (see Fig. 3).

Generally eight beads are implanted, but as many as 11 and as few as six have been used. Variations in the size of the sella and the accuracy of deposition of individual beads determines the total number deposited. Variations in the position of the nasal and sphenoidal septum can be an inconvenience, but do not prevent an adequate implant. Serial sectioning of the few pituitaries obtained at autopsy have revealed that an average of better than 90 per cent destruction has been obtained by this method (see Figs. 4, 5).

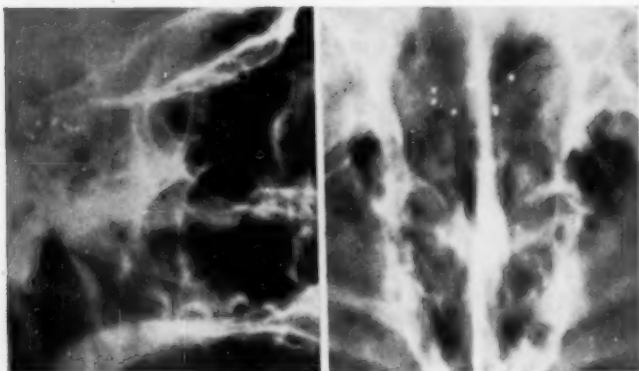


Fig. 3. Implant obtained in Case 1. Lateral and axial views.

Even severely debilitated patients stand the outlined procedure very well. On two occasions, however, it has been necessary to give an additional 50 mgm. of Demerol intravenously while the patient was on the table. Only one patient was deemed unfit for operation, when she became drowsy and confused on the day tentatively planned for operation; she died nine days later.

MAINTENANCE.

All patients subjected to this procedure have required a maintenance dose of Cortisone; on the average this has been 50 mgm. daily. Pitressin tannate has been administered to those patients developing diabetes insipidus. Thyroid replace-

ment has not been started until signs of hypothyroidism develop, and this does not occur for at least two months postoperatively.

MATERIAL.

Although some 40 of these operations have now been carried out since June, 1957, only the first 26 will be reviewed, for at least two months are required to determine the effects

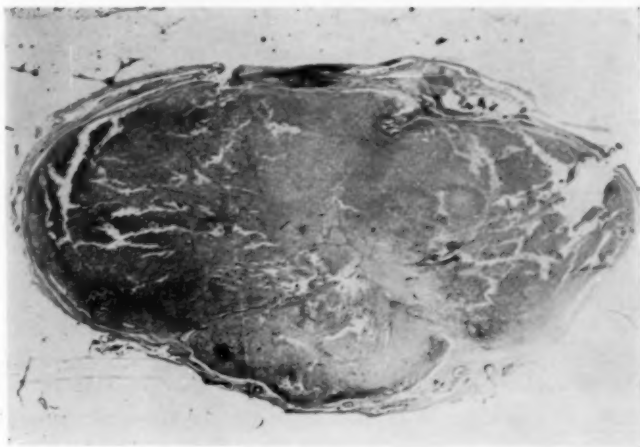


Fig. 4. H. and E. X 9. Pituitary obtained 15 days postoperatively from Case 1, showing almost total destruction.

of the procedure. It is as well to point out at this stage that these cases were unselected, insofar as no consideration was given to the age and general condition of the patient, the type of the primary tumor or site of metastases and previous treatment received by the patient. They were all considered to be unlikely to benefit from further surgery, radiotherapy or endocrine therapy; furthermore, the early operations were performed on patients who were in a very advanced, or even terminal stage of metastatic disease.

MORTALITY.

Of the 26 cases under review there were no deaths directly due to the procedure. One patient died two months postoperatively, and from the doctor's account of the terminal stage death probably resulted from meningitis. Unfortunately, autopsy was not obtained. This patient had developed a permanent cerebrospinal rhinorrhea two weeks postoperatively, and although she returned to the hospital it was

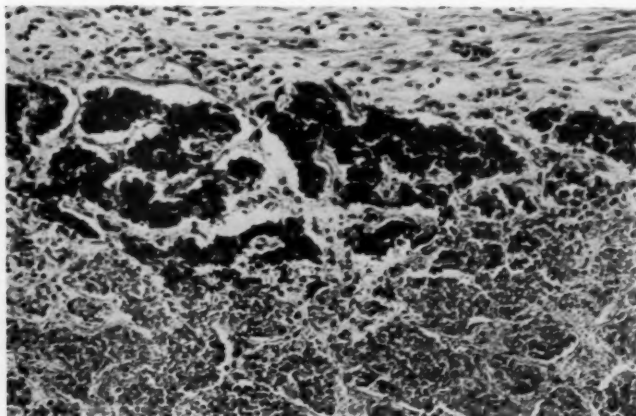


Fig. 5. H. and E. X 150 of surviving cells; note sharp line between surviving and necrotized cells.

decided that she was unfit to undergo transcranial closure of the defect, and was sent home again. This indicates rather well the "poor risk" cases that stand the procedure so satisfactorily.

COMPLICATIONS.

Thirteen out of 26 patients developed one or more of these complications.

By far the most frequent complication, ocular nerve paralysis, developed in no less than 10 patients. Eight suffered from a IIIrd nerve paralysis, either alone or in combination

with a IVth nerve paralysis. This is embarrassing for the patient, due to the drooping of the lid, but is no real handicap. Two developed a temporary VIth nerve paralysis, which was rather distressing, due to the double vision which resulted. One case of IIIrd nerve paralysis has started to clear after being present for two months.

Examination of pituitaries obtained at autopsy have confirmed the suspicion that these paralyses arise from placing beads too far laterally. The technique has been modified

TABLE I.
Complications in 26 Operations.

Extra-ocular N palsies	10
Cerebrospinal rhinorrhea	4
Meningitis	2
Anesthesia of face	1

accordingly. Surgical trauma at the time of operation plays no part in this complication, as the onset of paralysis is from the third to the sixtieth day.

Using this route it was expected that cerebrospinal rhinorrhea might present—it has occurred in four patients. In two patients it lasted for a number of months. One was the patient already mentioned, who was suspected of having died from meningitis two months postoperatively. The other was a man who had metastatic carcinoma of the prostate. The rhinorrhea lasted two-and-a-half months, but the patient has now returned to work. The two other cases of rhinorrhea were of a very temporary nature.

Starting with the twentieth case topical thrombin has been injected into both sphenoid sinuses, with penicillin, at the time of operation, as indicated. It is interesting that all these cases of rhinorrhea occurred within the first 14 operations, but this complication still occurs. In the last 26 cases, two have developed temporary rhinorrhea.

Meningitis was encountered twice: first, in the patient who is suspected of having died from this complication; and the other, in a patient who against advice blew her nose

vigorously. She suffered a temporary leak of cerebrospinal fluid and developed meningitis. This responded to antibiotic therapy and the rhinorrhea ceased.

During two procedures pellets were misplaced. In one it is assumed that they entered the cranial portion of the left carotid and were whipped into its branches, two settling in the distribution of the middle cerebral of the same side, and another entered the circle of Willis, crossed to the other side

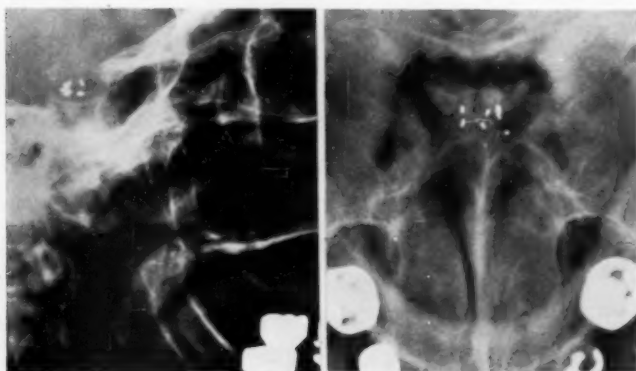


Fig. 6. Lateral and axial views of implant obtained in Case 9.

and came to rest in the distribution of the anterior cerebral artery. There were no after effects.

In the other case a pellet came to lie at the right petrous apex. As a consequence of this the patient has developed a mild sensory loss on the right side of the face in the distribution of the ophthalmic and maxillary divisions of the Vth nerve.

Although the complication rate in this series has been fairly high it can be reduced with experience. This is evidenced by the absence of any complications following operation in the last ten patients subjected to this procedure since December 1, 1957.

There have been no instances of anosmia, visual field

impairment, frontal lobe or hypothalamic damage, or brain abscess formation such as have been reported in other series.

RESULTS.

Of these 26 patients 21 had a primary lesion of the breast, four of the prostate and one of the ovary.

TABLE II.
Operations Performed.

Performed for Metastatic Carcinoma of Breast (F.—20, M.—1).....	21
Performed for Metastatic Carcinoma of Prostate	4
Performed for Metastatic Carcinoma of Ovary	1
Total	26

CANCER OF THE BREAST.

The 21 cases of metastatic cancer of the breast consisted of 20 females and one male.

TABLE III.
Carcinoma of the Breast.

Surviving—	
Unchanged	5
Improved	10
Dead—	
Unchanged	5
Improved	1
Total	21

Eleven appeared to benefit from the operation.

The estimation of the result of the operation is based on clinical observations such as cessation of vomiting, increase in appetite, weight gain, changes in size of cutaneous or sub-cutaneous lesions and X-ray studies of metastatic lesions. Symptomatically, relief of pain has been the most dramatic feature of those gaining benefit from the procedure; however, only four have shown a true regression with sclerosis of osteolytic deposits, etc. (see Figs. 6, 7, 8).

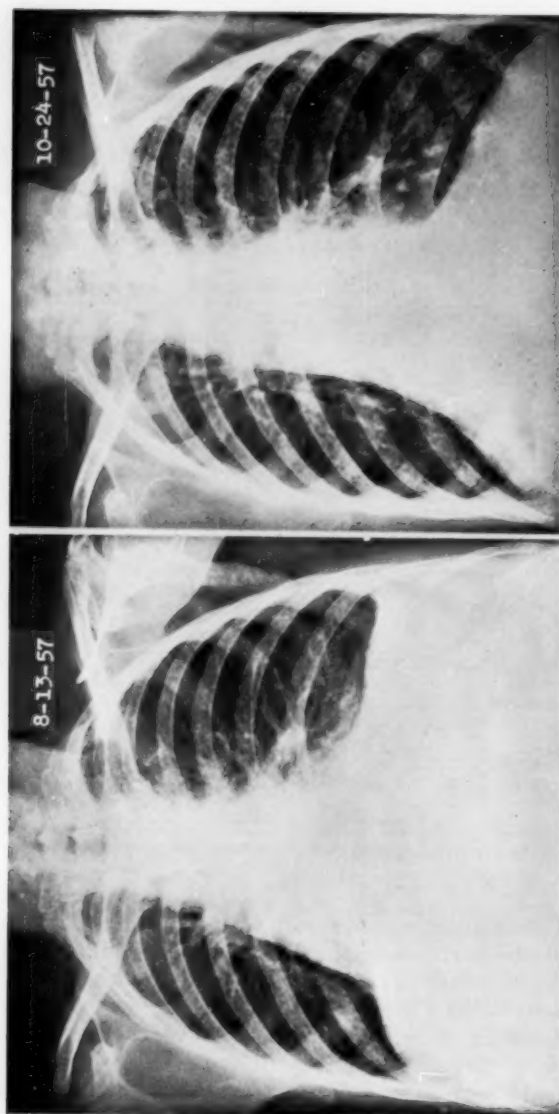


Fig. 7. X-rays of lungs before and 10 weeks after operation in Case 9.



Fig. 8. X-rays of pelvis before and 10 weeks after operation in Case 9.

CARCINOMA OF THE PROSTATE.

All four patients showed improvement after yttrium implant. This was evidenced by return of appetite, disappearance of bone pain, resumption of ambulation or return of normal urinary function.

The patient who had metastatic carcinoma of the ovary did not gain any benefit from the operation.

CONCLUSION.

As has been stated, virtually all patients referred with advanced cancer of the breast and prostate have been accepted for this procedure. It is felt that with better selection of cases the percentage of patients benefiting will increase, and with more experience and knowledge gained from autopsy studies the complication rate will continue to decrease.

SUMMARY.

Routes to the pituitary and methods of destruction are reviewed.

A simple method of yttrium implant of the hypophysis with continuous fluoroscopic control and under local anesthesia is outlined.

The results, obtained by 26 such procedures performed on patients suffering from advanced cancer are presented.*

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*We acknowledge our indebtedness to Dr. J. P. Evans for his assistance and advice, and to Dr. P. V. Harper, Jr., for arranging the supply of yttrium 90.

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REHABILITATION OF THE LARYNGECTOMIZED.

The University of Texas Postgraduate School of Medicine and the Houston Speech and Hearing Center will present the second training course in "The Rehabilitation of the Laryngectomized" from June 9 through 20, 1958.

The course this year will be altered in several ways as a result of experience gained from last year's presentation and will cover Vocational Adjustment, Anatomy of the Speech Mechanism, Normal Speech and Voice Production, Esophageal Speech and Voice, Laryngeal Surgery, Radiation Therapy, Facts about Cancer and Techniques in Teaching Esophageal Speech.

The general presentation will combine both the clinical and didactic approach.

Applications for Traineeships, which are limited in number, should be made as soon as possible, and will not be considered after May 19, 1958.

Inquiries concerning this course should be directed to: The University of Texas, Postgraduate School of Medicine, 410 Jesse Jones Library Building, Texas Medical Center, Houston 25, Texas.

RESULTS WITH THE CHISELS IN STAPES MOBILIZATION.*

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and

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When the stapes mobilization operation was first described by Rosen in 1954¹ there were many skeptics. Some said that the operation was doomed to failure because labyrinthitis was apt to ensue in many patients; some felt certain that early re-ankylosis would occur, and others said that the operation had been tried before and discarded because of poor results. Time has shown that this early skepticism was not justified, for the greater proportion of successfully mobilized patients have not experienced re-ankylosis, and very few have had serious complications. We must attribute much of the success of the stapes mobilization operation to the invention of the operating microscope with built-in light, which finally has provided adequate visualization for the otologists, and to the development of antibiotics which are used to reduce the incidence of post-operative infection.

The technique of mobilization has undergone a rapid transition from the original Rosen method to direct footplate techniques which have resulted in a higher percentage of successful results. The original technique described by Rosen consisted of applying pressure to the neck of the stapes so as to mobilize the footplate by tilting it in the oval window. Many otologists, including Rosen, were dissatisfied with the results because of the high incidence of crural fractures and, there-

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fore, tried maneuvers in which a rocking force was applied through the incus and incudo-stapedial joint. This resulted in a greater success rate, but crural fractures were still too frequent, and it soon became obvious that many fixed footplates could not be mobilized by forces exerted through the crura. The procedure passed rapidly, therefore, into the next stage in the evolution of methods to mobilize the footplate, this being the direct method by which cutting, prying, hammering, needling, chiseling and drilling techniques are used directly on the margins of the footplate. Among the first to use the direct method extensively in this country were House² and Goodhill,³ who needled the margins of the footplate; whereas in Europe, Heermann⁴ of Essen reported success with chisels, and Meurman⁵ of Helsinki with serrated knives. More recently, Portmann⁶ of France and Shea⁷ in this country have utilized a micro-drill to lyse otosclerotic foci, but their experiences are, as yet, not adequate to predict whether the method will enhance existing techniques.

I (H.F.S.) visited Professor Zöllner at the University of Freiburg in November, 1956, and saw him demonstrate the method of mobilizing the stapes with the chisels of Heermann. I used these instruments on a series of patients, and when Heermann attended the International Congress of Otolaryngology in Washington, D. C., in May, 1957, I had an opportunity of discussing the method further with him. Since that time, I have been using the chisels exclusively in all our mobilization operations. The early results are good enough to justify enthusiasm for the method, and the main purpose of this paper is to describe the technique and to present our experiences with it. We will also show our results with previous techniques.

GENERAL INFORMATION.

Our indications for surgery have been the same from the beginning; *i.e.*, any patient with a clinical picture of otosclerosis who has a bilateral air conduction hearing loss averaging over 30 db. for the speech frequencies (500, 1000, 2000), with no restrictions as to age or level of bone conduction thresholds. Patients who have no chance of improving

their air conduction thresholds to practical hearing levels because of sensory-neural deafness and who experience a successful mobilization were usually greatly pleased with the comfort afforded by the lower amplification requirements. The ear with the poorest hearing was always operated first, and only if the hearing improved beyond the opposite ear was the opposite ear operated. Patients with unilateral otosclerosis were subjected to surgery only if they felt that their hearing loss was an occupational or social handicap (seven of 269 ears).

The operations all were performed with local anesthesia by the trans-tympanic route. The head light and 2.5 power loupe were used for some early cases, but nearly all were done with the aid of a Zeiss operating microscope. For the past year, this instrument has been used for the entire operation.

The patients were discharged from the hospital the day following surgery unless they complained of vertigo. Tetracycline, 250 mgms. every six hours, was given for five days post-operatively.

CRITERIA OF SUCCESS AND FAILURE.

We have not rated our patients into classes of predicted success, as is done for patients being considered for fenestration surgery, because for stapes mobilization we are not restricted by the bone conduction levels. From October 25, 1954, to December 1, 1957, two hundred and sixty-nine mobilizations were performed, most of these being performed in the past year. We have determined the success rate for each of the three groups of patients in which the tilt (22 ears), needle (106 ears) and chisel (144 ears) techniques were used (see Fig. 1).

We (A.B.G. and M.R.C.) administered all pure tone tests in acoustically-treated rooms with an ambient noise level of less than 50 db. in the critical frequency bands with commercially available clinical audiometers. The calibration of each audiometer was standardized regularly with the Allison calibration unit, Model 3A. Speech tests were administered either with the above equipment or, using the regularly calibrated

speech audiometer, in a two-room testing unit, using monitored live voice techniques.

Thresholds for bone and air conduction throughout have been stated in terms of the equivalent S.R.T. as determined by the Fletcher formula. The Fletcher formula is the average of the two best threshold responses for 500, 1000 and 2000 c.p.s.

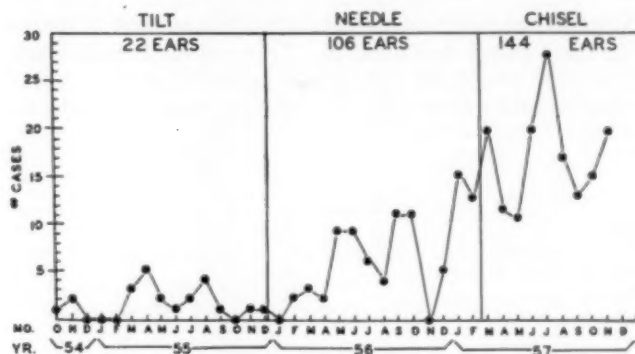


Fig. 1. Chart showing the operative method, number and date of 269 stapes mobilization operations.

CLASSIFICATION OF RESULTS.

1. Successful:
 - a. 30 db. or better pure tone threshold.
 - b. 20 db. or smaller bone-air gap.
2. Improved:

10 db. or more improvement of pure tone threshold but not successful.
3. Unchanged:

Less than 10 db. change of pure tone threshold.
4. Hearing Loss:

10 db. or more loss of pure tone threshold.

The three groups were rated in terms of early and late successes, the early successes being determined by audiometric tests taken about one month after operation, and the late successes three months or longer after operation; thus, the average time after operation for the late tests was eighteen months for the "tilt" ears, six months for the "needle" ears, and four months for the "chisel" ears.

TILT TECHNIQUE.

After I first saw Rosen demonstrate his method in October, 1954, I attempted to follow it. As much as I dislike introducing new terminology, I cannot bring myself to describe my own attempts to mobilize by applying pressure to the neck

TABLE I.
Tilt Method—22 Ears.

Success:		
Early (1 month)	4	(18%)
Late (average 18 months)	3	(14%)
Improved	6	
No Change	12	
Loss	1	

of the stapes as the "Rosen method", for to do so would be no compliment to Rosen. Obviously he had developed a degree of skill in applying this force which eluded me, for my attempts to rock or tilt the stapes very often resulted in crural fractures. The results are shown in Table I.

NEEDLE TECHNIQUE.

I was very grateful when House and Goodhill showed me their techniques in January, 1956, which consisted of the skillful application of force to the head of the stapes by a needle and, if that failed, by prying, pushing and cutting the margins of the footplate with sharp needles, great care being directed at mobilizing the footplate without breaking the crura. During 1956 and early 1957 I utilized the needles to the best of my ability on one hundred and six ears. Results are shown in Table II.

The results were far more gratifying than those accomplished with the tilt technique, but at the end of six months, 20 per cent of the early successes had again lost their gain.

CHISEL METHOD.

Whereas the mild and moderate ankylosis could be mobilized quite satisfactorily with needles, the method was not often successful in mobilization of the more severely ankylosed footplate. The next logical step was the use of chisels to cut through the otosclerotic foci. For the development of the

TABLE II.
Needle Method—106 Ears.

Early Results: (1 month)		
Successes: Threshold	60	
Bone-Air Gap	6	62%
Improved	11	10%
No Change	27	26%
Loss	2	2%
No Early Record	1	1%
Late Results: (Average 6 months)		
Successes: Threshold	44	
Bone-Air Gap	6	47%
Improved	10	9%
No Change	33	31%
Loss	4	4%
No Late Record	9	9%

technique and the design of the instruments, we are indebted to Heermann. I may not use the instruments in precisely the manner that he does, but this is not important as long as the end result is lysis of the stapedial footplate in continuity with one or both crura. Heermann first designed a slightly curved and a straight chisel* which I now refer to as the "heavy" models and which I use first on all but the very thin otosclerotic foci. About six months ago he designed lighter models which I use continuously, and refer to as the curved, reversed-curved, and straight "light" models. In order that the reader may gain a clear impression of the shape and size of the chisels in relation to the stapes, they are shown to scale in Fig. 2.

*Available from F. L. Fischer Co., Freiburg im Breisgau, Germany.

The injection sites, skin incisions, position of the hands when holding the chisel and the normal view of the operative field are seen in Fig. 3. The skin flap must be large enough to cover the defect left by removing bony annulus posteriorly and to allow inspection of the round window. Bony annulus can be removed with either curettes or burs. Accumulation of bone dust makes the bur somewhat objectionable. Some-

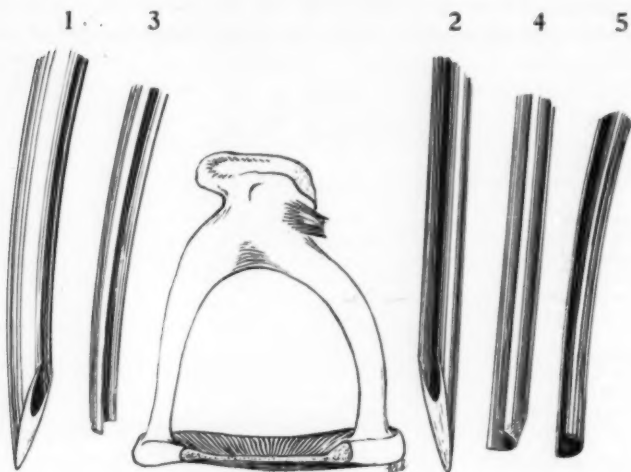


Fig. 2. Drawing of normal stapes with part of footplate margin cut away to show thin central region and views of the chisel points, drawn to scale and enlarged. For the anterior margin of the footplate Chisel 1 (heavy curved) and Chisel 3 (light curved) are usually best suited, although No. 2 (heavy straight) and No. 4 (light straight) may be better in some cases. Nos. 2 and 4 are used for the superior margin and No. 5 (reverse curved) for the posterior margin.

times electrocautery is needed to control bleeding from the skin incisions. The chordo-tympani nerve usually is reflected downward, but occasionally upward, so as to preserve it. The stapes is touched gently with a needle to determine whether it is fixed. In only one ear (of 269) was a mobile stapes found, and this ear was one of three with total round window closure, the others having stapes ankylosis in addition. Curtains and bridges of mucous membrane are cut away, if neces-

sary, to acquire the best possible view of the crura and footplate. I make no attempt to mobilize the stapes with trans-incudal or trans-capitulum force, but proceed immediately to make the first chisel placement anterior and adjacent to the anterior crus so as to cut through the anterior otosclerotic focus.

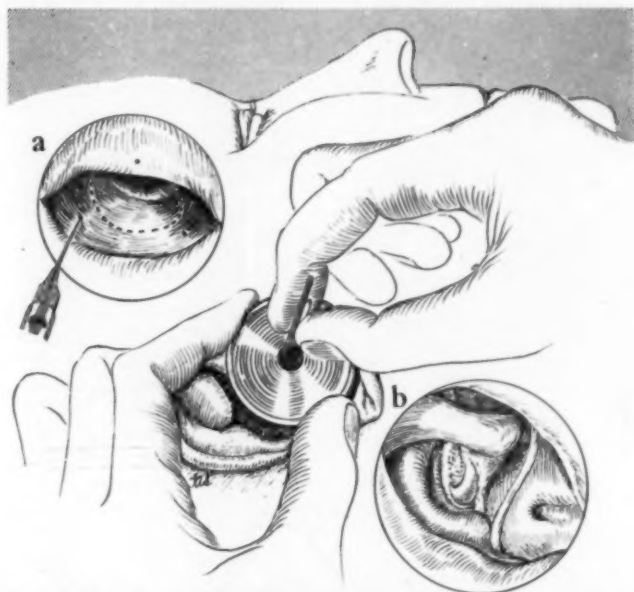


Fig. 3. a. Sites of injection for anesthetic agent (3 dots) and location of mental incisions (broken line). b. Typical view of operative field. Center: Method of placing chisel, utilizing 10 to 16 power magnification.

A handle can be purchased to hold the chisels, but I prefer to hold the chisel in position by grasping the small tab located on the shaft with the bare fingers of either the left or the right hand, whichever is the most convenient, while the opposite hand holds the speculum. The nurse or assistant taps the chisel with a small hammer, using light to heavier blows, as directed by the operator. Sometimes the nurse holds the speculum, leaving the operator's opposite hand to

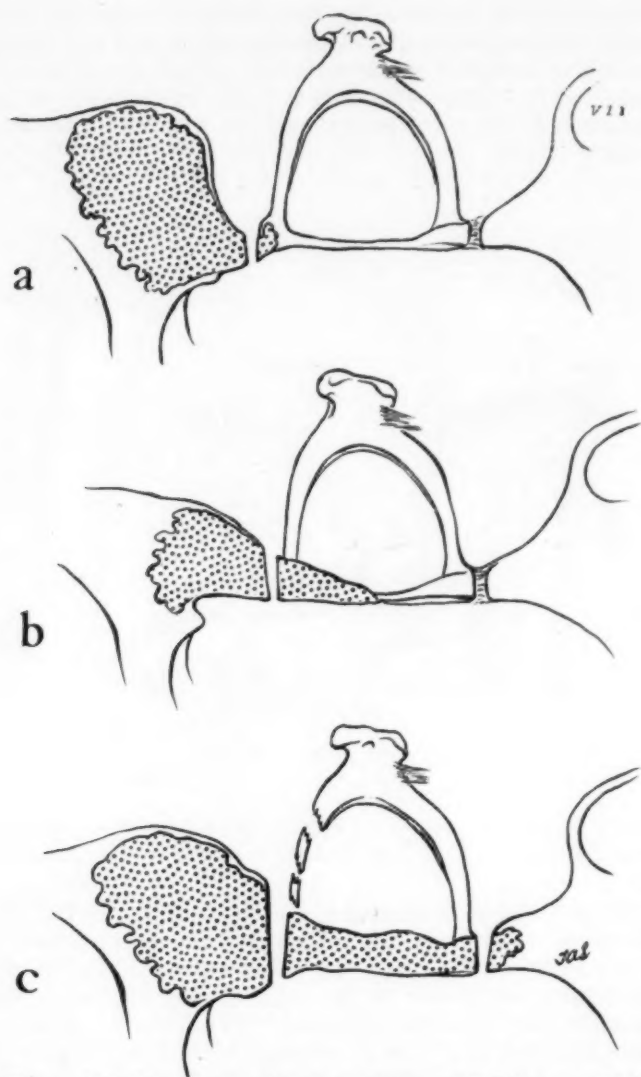


Fig. 4. Objectives to be achieved in stapes mobilization in mild (a), moderate (b) and severe (c) otosclerotic lesions.

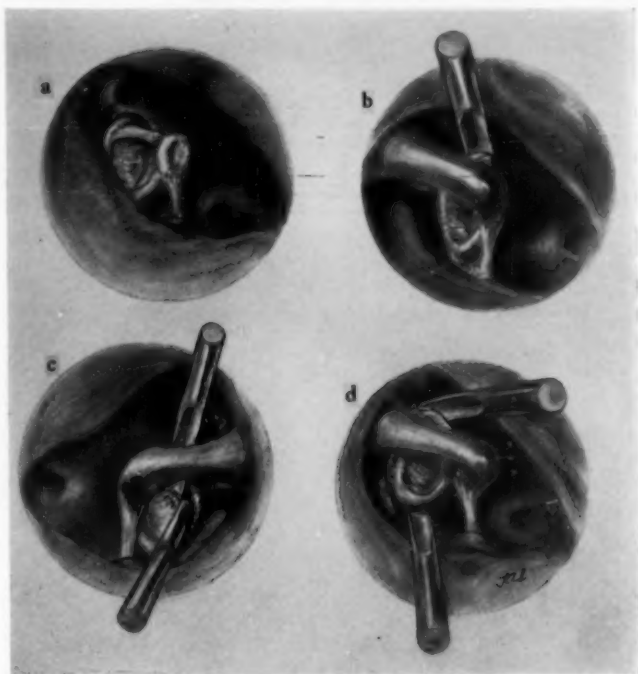


Fig. 5. a. Incus removed in cadaver specimen to show anatomy of footplate region. b. Chisel placed at anterior margin of footplate. c. Chisels placed anteriorly and superiorly. d. Chisels placed anteriorly and posteriorly.

wield the hammer. The curved chisel is best suited to the anterior margin of the footplate, although the straight ones can be used in some cases; the "heavy" model being used first until a slight movement of the stapes is seen, after which the "light" model may be used to cut the remainder of the focus. With two or three light taps of the chisel, thin otosclerotic foci will be cut, and total mobilization of the stapes will be accomplished. For thick and extensive otosclerotic foci the "heavy" model chisel may be used in two or three anterior locations, so as to circumferentially cut the focus. Then the straight "heavy" or the straight "light"

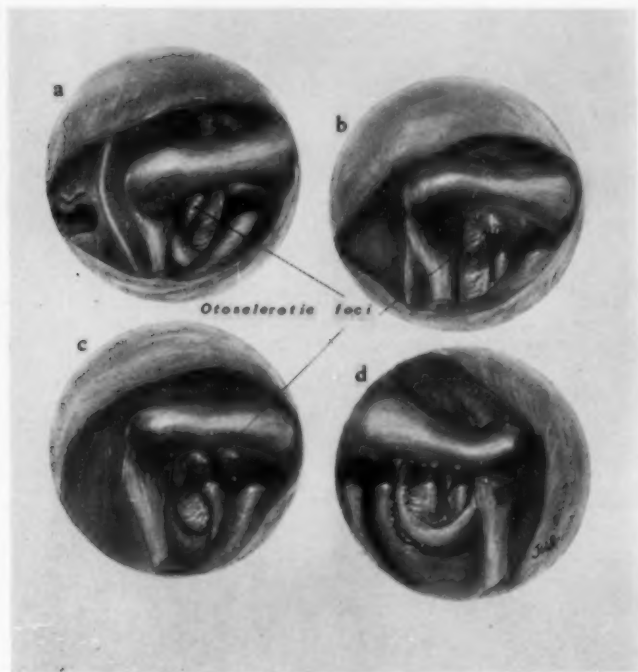


Fig. 6. "a", "b" and "c" show moderate otosclerotic lesions as seen at operation. "d" shows a dense otosclerotic lesion involving the entire footplate. Chisel marks can be seen along both superior and inferior margin. It was impossible to accomplish mobilization in this ear. There were five such cases in the total of 269.

model chisel is used superiorly, and the reverse curved chisel is used posteriorly to accomplish further lysis as necessary.

Occasionally there are linear fractures through the footplate when the operation is completed, but this is not serious so long as one or both crura remain intact and in continuity with part of the footplate.

In ears with very thick, extensive otosclerotic foci, it is not possible to preserve the continuity of the anterior crus, but in these cases a thorough lysis of part of the footplate must be accomplished with the posterior crus providing the colum-

nella effect. The objective of mobilization in mild, moderate and severely ankylosed stapes is seen in the diagrammatic sketches in Fig. 4.

After the footplate is loose, a needle is inserted into the incudo-stapedial joint and rocking movements, as well as in-and-out movements, are made to insure complete mobilization of the stapes, using care not to dislocate the incudo-stapedial joint. A disarticulated, or subluxated, joint should be avoided.

TABLE III.
Chisel Method.

Early Results: (1 month)	144 ears		
Successes:			
Thresholds	99	69%	
Bone-Air Gap	10	7%	76%
Improved	20		14%
No Change	12		8%
Loss	3		2%
Late Results (average 4 months)	74 ears		
Successes:			
Thresholds	49	66%	
Bone-Air Gap	4	6%	72%
Improved	9		12%
No Change	10		13%
Loss	2		3%

ed, for this might result in some hearing loss, and a few db. one way or another can be critical for the patient.

Surgical audiometry, that is, hearing testing in the operating room, is employed in all operations using the Ambco Otometer. In general, hearing improvement in the operating room indicated a successful mobilization, but many ears which did not improve in the operating room also had a subsequent good result. We continue to use surgical audiometry but do not consider it essential for successful surgery. A much more reliable indicator is the surgeon's visual and tactile impression of the state of mobility of the stapedial footplate.

The most common chisel placements are shown in Fig. 5. Some common otosclerotic lesions are seen in Fig. 6 and were sketched by Mr. Stebbins at the time of operation. The

results of the chisel method are shown in Table III. The chief reason why we have late results only on 74 of the 144 ears, is that 43 operations were performed less than three months before the analysis was made, and 12 patients lived out-of-town and were inaccessible. An interesting difference between the chisel group and the needle group is that the percentage of late successes (three months or longer) is almost as high as the early successes (one month). The number of patients who lost their early hearing gain was somewhat less, but the main difference was that a number of patients passed from the improved to the success group after one month.

COMMENTS.

The complications for this entire group of 269 operations are summarized as follows:

Tears of the tympanic membrane.....	25
Persisting perforations	0
Profound hearing losses	2
One sterile labyrinthitis; one cause unknown.	
Otitis media (after five days)	3
Otitis externa	4
Postural vertigo	2

Hearing losses were experienced in eight (3 per cent of 269 ears. The cases are listed as follows:

Tilt (1 of 22) :

12.5 db., cause unknown.

Needle (4 of 106) :

15 db., pneumatic hammer.

15 db., stapes depressed into oval window.

15 db., cause unknown.

Profound loss—initial success—loss after laparotomy.

Chisel (3 of 144) :

10 db., cause unknown.

Profound loss, sterile labyrinthitis.

10 db., footplate fenestration with removal of incus.

It is interesting to note that nine ears were re-operated and of these success was attained in six. The high success rate of re-operated ears probably is because the chisel method was used in the second operation. The results are summarized as follows:

METHOD.	
Original Operation	Re-Operation
Tilt.....3	Needle.....1
Chisel.....6	Chisel.....8
9	9

RE-OPERATION RESULTS.		
	Unchanged	Success
Needle	1	0
Chisel	2	6
	3	6

SUMMARY.

The stapes mobilization operation was performed on 269 patients between October, 1954, and December, 1957. The late success rate (three months, plus) utilizing the tilt technique was 14 per cent of 22 ears; with the needle technique it was 47 per cent of 106 ears; and, with the chisel technique it was 72 per cent of 72 ears.

The chisels designed by Heermann are effective instruments for mobilizing the footplate while preserving the continuity of one or both crura and maintaining thereby the columella effect.

Acknowledgments: We express our appreciation to Mr. Thomas Stebbins for his illustrations, and thank Mr. David Shephard, Mr. Dennis Bagaria and Mrs. Harold F. Schuknecht for their assistance in analyzing the audiometric data.

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PROGRAM OF THE SEVENTH INTERNATIONAL CONGRESS OF BRONCHOESOPHAGOLOGY.

Meeting Place—Kyoto University, Kyoto, Japan.

Friday, September 12th, 1958

8:00 P.M.-10:00 P.M.—Reception (Party) Shimomura
House in Kyoto.

Saturday, September 13th

8:00 A.M.—Inaugural Session (in Kyoto University Hall).

9:00 A.M.-12:00 M.—First Scientific Session.

12:00 M.-2:00 P.M.—Luncheon (Reception. The Place not
decided).

2:00 P.M.-6:00 P.M.—Sightseeing in Kyoto.

8:00 P.M.—Banquet, Miyako Hotel.

Sunday, September 14th

8:00 A.M.-11:30 A.M.—Second Scientific Session.

11:30 A.M.-12:00 M.—Closing Ceremony.

12:00 M.—Departure for sightseeing in Nara.

1:00 P.M.—Luncheon, Nara Hotel.

2:00 P.M.-6:00 P.M.—Sightseeing in Nara.

7:00 P.M.—Return to Kyoto.

A GUIDE FOR STAPES SURGERY BASED ON A NEW SURGICAL CLASSIFICATION OF OTOSCLEROSIS.*

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A better appreciation of the gross pathology of otosclerosis involving the oval window and stapes had been obtained with the introduction to otology of the surgical microscope. Although the binocular loupes and headlamp were considered satisfactory at one time, it seldom was possible with this equipment to obtain a precise concept of the otosclerotic involvement or to appreciate the results of the mobilization procedure. In retrospect, the mobilization operation as introduced by Rosen¹ can be considered a gross procedure which does not account for the variations in type and distribution of the otosclerotic lesion. In the original description of the operation, a clear view of incudo-stapedial joint and stapedius muscle tendon was considered sufficient visualization, and the procedure simply required the application of the force to the neck of the stapes in the direction of the stapedius muscle tendon. No investigation of the footplate was considered necessary, and poor visualization had to be supplemented by a keenly developed tactile sense. This type of surgery produced successful results in comparatively few patients—presumably those with early and small otosclerotic lesions. In the more advanced cases, both crura were often fractured before the stapes footplate could be mobilized. The application of force either to the head and neck of the stapes or by the trans-incudal technique^{2,3} without adequate visualization of the otosclerotic lesion at the footplate did not permit an opportunity to modify the technique according to location and degree of pathology; consequently, only cases of minimal otosclerotic involvement could be mobilized, accounting for

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the low percentage of good results obtained by these techniques.

It is generally accepted that the best results are obtained when the crura of the stapes are not damaged during the mobilization procedure. It is through the intact ossicular chain that sound pressure normally is transmitted to the oval window, and every effort should be made to preserve this natural route of conduction. It is not rational, therefore, to fracture the crura and then attempt to mobilize the footplate of the stapes. The technique of mobilization in which the forces are applied either to the head and neck of the stapes or by trans-incudinal means have now been discarded. All mobilizing forces are applied directly to the point of fixation at the footplate which considerably diminishes the risk of fracturing the crura before the footplate of the stapes can be mobilized.

The application of the mobilizing forces directly to the footplate had not been safe when no more magnification was available other than the loupes and headlamp. With high magnification the footplate of the stapes can be manipulated under the combined sensations of touch and binocular vision making possible positive control over the mobilizing force. Surgical penetration through the footplate into the vestibule during the mobilization operation rarely occurs when the stapes is visualized under high magnification, and consequently vertigo is experienced in very few cases.

High magnification also permits the careful examination of the position, extent and character of the otosclerotic lesion.⁴ It is then possible to modify the mobilization technique according to the pathology encountered. As an excellent exposure of the footplate is obtained in over 90 per cent of the cases, there are few occasions when the surgeon does not have the operation under his complete visual control. With the use of the microscope, the pathology can be seen clearly, and a carefully planned course of mobilization procedure can be chosen. In less than 10 per cent of the cases the field is obscured by the tortuosity and size of the external auditory canal or by the anatomical variations in the position of the oval window in the middle ear. At times the middle ear

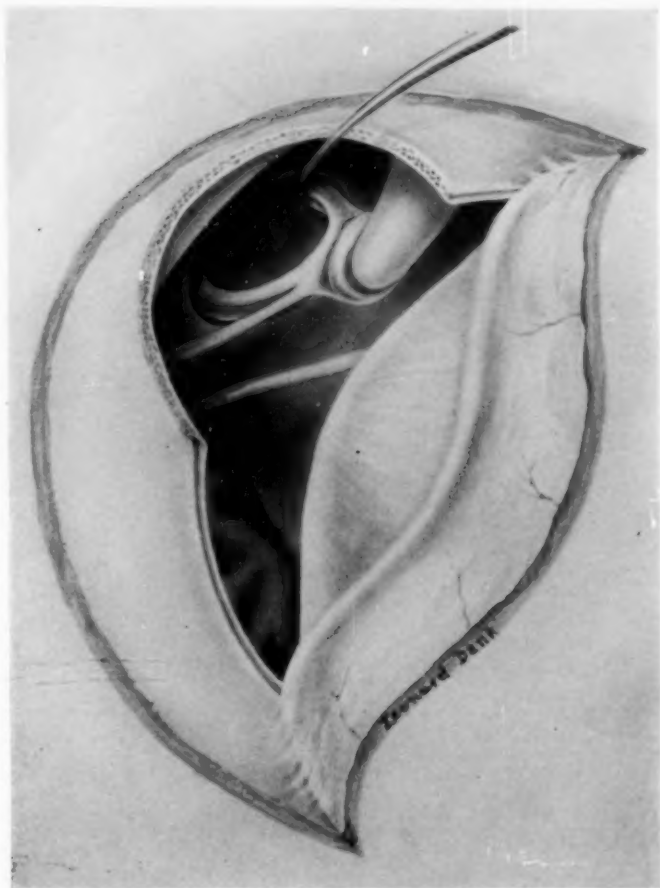


Fig. 1. Class I—Early Otosclerosis. Stapedio-vestibular joint space is not reduced and otosclerosis is not visible. The footplate appears thin and bluish in color.

structures are situated so far posteriorly with respect to the external auditory canal that the incus is not visible when the drum is reflected. In these cases the bone of the posterior canal wall must be removed widely over the incus at the annulus. The removal of bone in this area is a relatively

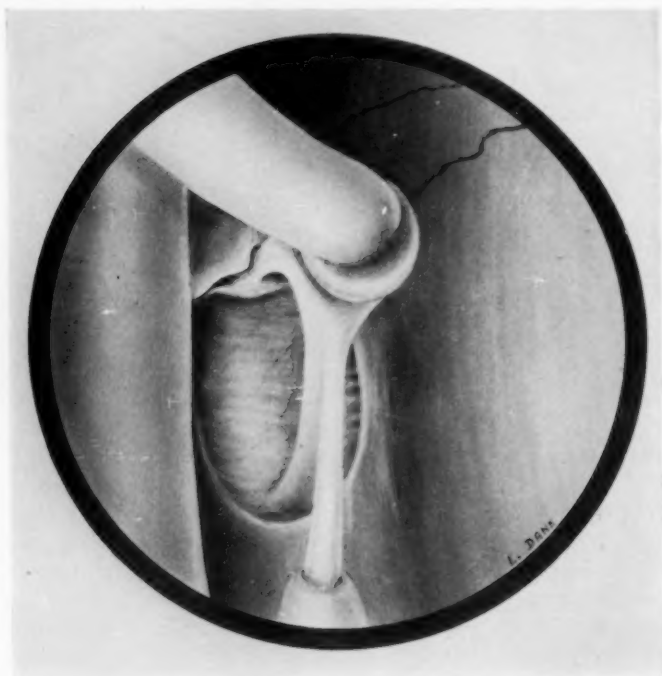


Fig. 2. Class II—Moderately Advanced Otosclerosis. Stapedio-vestibular joint space is bridged by an otosclerotic lesion which has advanced from the vestibular wall to the adjacent portion of the footplate. The joint space is visibly narrowed but the crura of the stapes are not involved in the lesion.

safe procedure and should not compromise adequate visualization of the stapedial footplate.

Anatomical variations within normal limits often occur in the region of the oval window and the stapes. The crura of the stapes vary in size considerably. Some are extremely fragile and are injured easily. The crura also may assume a variety of positions with regard to the surrounding structures. Quite unfavorable for surgery is the deeply seated footplate in an oval window area which has a high lip at the promontory side or a facial nerve which overhangs the oval window impairing direct visualization (see Fig. 6). The

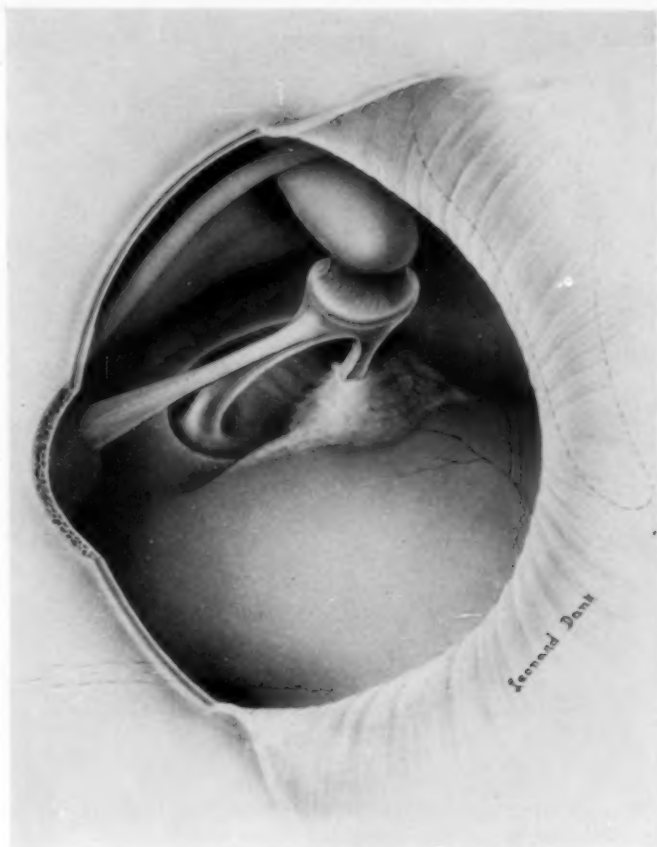


FIG. 3. Class III—Advanced Otosclerosis. Large otosclerotic lesion which obliterates the stapedio-vestibular joint space and involves one crus of stapes. The other crus and most of the footplate are free of otosclerosis.

angulation and depth of the stapes in the oval window niche can be so unfavorable that it can impose a considerable handicap to the surgeon. Routinely, the mobilizing forces are applied only to those portions of the stapes footplate which are clearly seen. In these unfavorable cases visualization



Fig. 4. Class IV—Unfavorable for Mobilization. Reduction of oval window niche to a narrow slit preventing adequate visualization and controlled instrumentation. The facial nerve overhangs the footplate and the stapes is crowded by a large otosclerotic lesion which projects from the promontory.

poor, and blind application of the mobilizing instruments on the footplate is not recommended.

PALPATION.

Although adequate exposure and direct visualization of the oval window niche are important, much can be gained by careful palpation. It is possible to locate the region of fixation by applying gentle pressure with a needle in orderly sequence to the incus, incudo-stapedial joint, and head and crura of the stapes. Further palpation of the footplate directly will reveal information regarding the exact point of

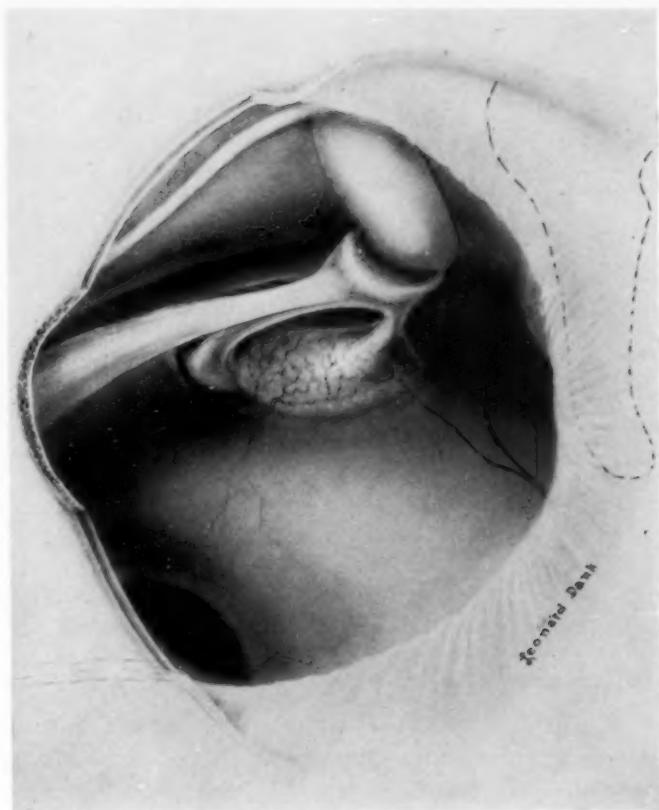


Fig. 5. Class IV—Unfavorable for Mobilization. Entire footplate of stapes has been replaced by otosclerosis.

fixation at the stapedio-vestibular joint. As the footplate normally has a slight degree of flexibility, it is possible, using light pressure of the needle, to observe slight motion of one mobile end of the footplate of the stapes when the other is fixed solidly by otosclerosis. The small amount of motion obtained when the stapes is bent can be appreciated only with binocular vision under high magnification. This information will direct the application of the mobilizing forces

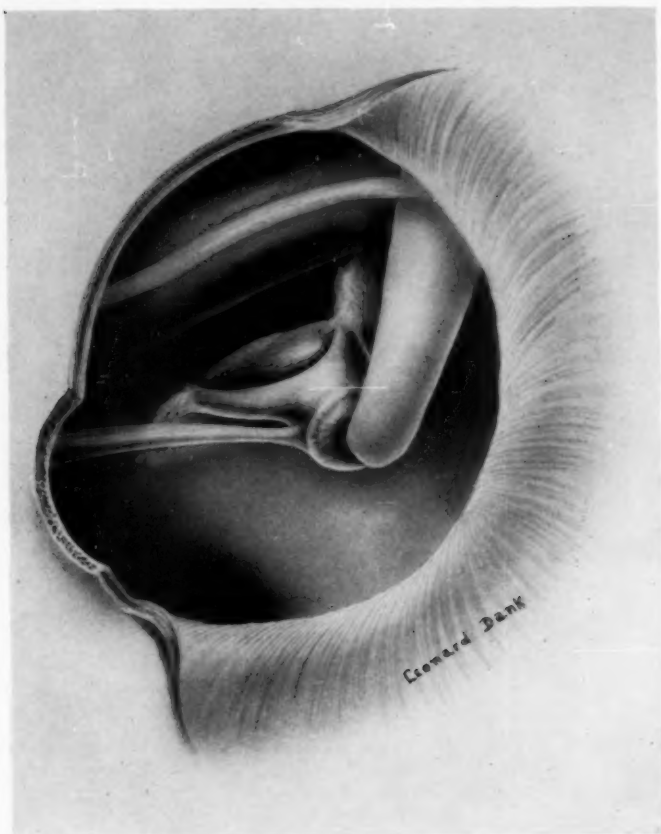


Fig. 6. Class IV—Unfavorable for Mobilization. Both crura are fixed by the otosclerotic lesion at the lip of the promontory. The footplate of the stapes rests in a very deep oval window niche and is obscured by a prominent facial nerve.

to the area involved by the otosclerotic lesion. Injury to other parts of the stapes not responsible, for the ankylosis can be avoided by these means.

The results of the mobilization procedure also can be determined accurately by palpation. Injured portions of the stapes can be easily recognized and should be noted. This informa-

tion is considered essential in evaluating any particular case for revision.

Following a successful mobilization it is possible to check the ossicular chain for continuity by observing the motion of the footplate when downward pressure is applied at the lenticular process of the incus. When the ossicular continuity has been preserved, motion induced in the footplate can be seen directly and is transmitted also to the round window niche where it can be visible. This provides conclusive proof that sound pressure is passing through the cochlea. Less emphasis, therefore, can be placed on subjective responses and audiometry in the operating room.

SURGICAL CLASSIFICATION OF OTOSCLEROSIS.

Adequate information for classification has been obtained when the exact location, nature and position of the otosclerotic lesion has been determined. The selection now can be made of a mobilization technique which will be the most suitable to manage the particular type of lesion encountered. When sufficient surgical experience has been obtained in recognizing the variations in the distribution and degree of involvement assumed by otosclerosis, it can be understood easily why one mobilization technique can not give a satisfactory percentage of good results. In this study a higher percentage of good results has been obtained only when the technique of mobilization had been modified to meet the particular variations of the otosclerotic lesion. The operation for the mobilization of the stapes at this point takes on a new character. The presenting anatomy and pathology must be studied carefully and a surgical plan is formed either to circumvent the lesion when it is extensive, or to apply the mobilizing forces directly to the point of fixation causing separation through the otosclerotic lesion.

Although innumerable variations occur in middle ear anatomy and in the otosclerotic involvement, certain similarities have become evident which permit a classification on anatomic and pathologic basis. All cases can be catalogued within four general classes, and a surgical technique is described which is suitable to deal with each type of involvement.

Class I, early otosclerosis has been observed in 36 per cent of cases studied (see Fig. 1).

Characteristics:

1. Good exposure and visualization of footplate is possible.
2. No evidence of narrowing of stapedio-vestibular joint and no otosclerosis is visible.
3. The footplate of stapes is of a normal blue color, smooth and regular.
4. Palpation under magnification reveals fixation at one end of the footplate of the stapes; slight motion can be obtained at the other end.

Cases with early otosclerosis, in which the lesion is very small and not visible with the microscope, are grouped in this class. The otosclerotic lesion is assumed to be either entirely fibrous or containing a minimal amount of calcification. Usually mobilization is accomplished easily by gentle pressure of the needle at the point of footplate fixation. Needle pressure (forcing the footplate into the oval window) at the base of the crus near the stapedio-vestibular joint usually is successful when attempting to achieve footplate mobility (see Fig. 1). Penetration into the joint space is rare, as the mobilizing force is under the direct control of vision and touch, and escape of perilymph also is rarely seen. It is reasonable to assume that most cases which terminate successfully when the mobilizing force was applied to the neck or head of the stapes had minimal otosclerotic involvement and could be included in Class I. Those cases with more advanced lesions, such as those grouped in Classes II and III would have terminated unfavorably with the early techniques, as these lesions needed more force for footplate mobilization than could be applied through the crura of the stapes.

Class II, moderately advanced otosclerosis was observed in 41 per cent of cases (see Fig. 2).

Characteristics:

1. Good exposure and visualization of footplate is obtained.

2. Definite narrowing of stapedio-vestibular joint by visible otosclerosis is present. The lesion usually involves a portion of the footplate of the stapes but neither crus is involved in the otosclerotic lesion.

3. The usual normal blue color of the footplate has remained unchanged except for a region near the otosclerotic focus, where it is white and opaque.

4. Palpation under magnification reveals solid fixation at one end of the stapes. The other end exhibits slight motion.

In this study, most cases of otosclerosis presented the characteristics of Class II. Methods of mobilization which depend upon the strength of the crura are successful only occasionally when the otosclerotic lesion has advanced to this degree. Under these conditions the crura usually are not strong enough to withstand the pressure required to free the footplate, and fractures of the crura occur often when the mobilizing force is applied to the head or neck of the stapes. Application of the mobilizing force directly to the otosclerotic lesion at the footplate permits mobilization in many of these cases without the danger of losing ossicular continuity. The application of pressure, depressing the footplate into the oval window, with a sharp curved needle at the base of the involved crus nearest the fixation can be an alternate means of applying the mobilizing force. When this involvement is extensive, extreme care is needed to prevent penetration into the vestibule or injury to crura. When attempting to achieve mobility, the otosclerotic lesion can be weakened by many re-applications of superficial needle punctures performed under direct visualization. These punctures can be done safely under the control of vision and touch. During this type of mobilization there is usually a fracture of the footplate or separation of the stapedio-vestibular joint with a loss of a small amount of perilymphatic fluid. As the pressure has been applied only to the footplate, the crura usually remain intact. Occasionally the crus nearest the otosclerotic lesion may be injured. This is not of serious consequence as hearing improvement is possible when continuity is maintained between the intact crus and a mobile portion of the footplate.

The technique of applying the mobilizing force directly to otosclerotic lesion at the footplate has been most successful in Class II. Many of these cases would have terminated unsuccessfully with fractures of the crura if the mobilizing forces had been applied to head or neck of the stapes. Application of force to the otosclerotic lesion meets the resistance at the strongest point, providing greater opportunity for successful mobilization of the stapes. The difference in statistics published in 1956⁷ and those reported in this study represent chiefly the accomplishments of this present technique in this class of otosclerotic involvement.

Class III, advanced otosclerosis, was found in 14 per cent of cases studied.

Characteristics:

1. Good exposure and visualization of footplate is present.
2. A large otosclerotic lesion involves the stapedia-vestibular joint, one crus of the stapes, and a portion of the footplate (see Fig. 3).
3. Near the otosclerotic lesion, the normal blue color of the footplate is replaced by solid white opaque bone.
4. Palpation reveals solid fixation of the greater part of the footplate, but slight motion can be demonstrated at the uninvolved end of the footplate.

When a large otosclerotic lesion of this type is found no attempt is made to fracture directly through the lesion. The crus is divided above the otosclerotic mass as recommended by Fowler,⁵ permitting the uninvolved crus to maintain continuity with the uninvolved portion of the footplate. The footplate is fractured in its midportion by multiple superficial punctures with a fine curved needle. Usually there is an escape of perilymph through the fractured footplate. Occasionally other lines of fracture occur with fragmentation of the footplate into several parts. This is to be avoided as only a small fragment of the footplate may remain attached to the mobile crus, insufficient to permit transmission of sound pressures. Approximately one-half of the footplate attached to the functioning crus has been found necessary

to obtain a significant improvement in hearing; therefore, all efforts should be made to prevent fragmentation. A crus of the stapes resting in the perilymph of the oval window without an attached portion of footplate does not perform well, and a satisfactory improvement in hearing is usually not obtained.

Class IV, unfavorable for mobilization of the stapes, are cases with very advanced otosclerosis and those complicated by extremely difficult anatomic variations. Only nine per cent of cases in this study were found to have these characteristics.

Characteristics:

1. There is poor exposure and visualization of oval window due to extreme anatomic variations (see Fig. 4).
2. Large otosclerotic lesions may be seen, which have replaced the footplate completely with solid white bone obliterating the stapedio-vestibular joint (see Fig. 5).
3. Extensive otosclerotic lesions originating from the margin at the promontory and involving both crura are also unfavorable. Included are cases with apparently normal blue footplate, but the crura of the stapes are fixed solidly at the promontory edge (see Fig. 6). In these cases the footplate of the stapes lies deep in the oval window niche. The stapes is tilted toward the promontory lip and otosclerosis involves both crura just below the neck.

Cases with unfavorable prognosis regarding the application of mobilization procedures are grouped in Class IV. These cases are considered unfavorable when the anatomy of the middle ear is abnormal, permitting neither adequate visualization nor controlled instrumentation at the footplate; the prognosis is also unfavorable when both crura are fixed by otosclerosis. In these cases the footplate rests deep in the niche of the oval window, and fixation of the crura occurs usually at the lip of the promontory. The footplate itself may be normal in appearance, but continuity of the ossicular chain is usually interrupted in attempting to release the fixed crura from the promontory.

The prognosis also is considered unfavorable when the otosclerotic lesion has entirely replaced the footplate, obliterating the stapedio-vestibular joint. In this study the crura were found freely movable in two cases. In both a large otosclerotic mass had replaced the footplate completely and had reduced the crura to thin fibrous and flexible strands of tissue. Chisels, burs and hooks used to achieve mobility or fenestration of the footplate, when completely replaced by otosclerosis, were found to expose the labyrinth to undue risks. When confronted by anatomic and pathologic conditions characteristic of Class IV, mobilization of the stapes operation is not recommended, as the safety of a controlled operation is lost. It is preferable to consider the fenestration of the horizontal canal, which avoids this area of excessive otosclerotic involvement and provides the technical control required for this delicate surgery. House⁶ agrees with this point of view. Deliberate fenestration of the footplate has not been attempted as all cases in which the footplate has been fenestrated accidentally have had only a slight initial improvement in hearing which was lost within a relatively short time. It is well recognized that one type of medical or surgical management cannot be ideal for all variations of a disease process. This medical axiom should be applied to the stapes mobilization operation.

DISCUSSION OF RESULTS.

The results obtained in a series of 100 cases, considered ideal for fenestration surgery were reported in 1956.⁷ At that time it was believed valuable to establish a baseline for the new mobilization of stapes operation performed exactly as introduced by Rosen, using candidates ideal for the fenestration operation (horizontal semi-circular canal). Attempts to represent statistically all cases acceptable for mobilization surgery, including those with weak cochlea function, yet possessing some degree of cochlea reserve, produced considerable confusion in the presentation of results; therefore, only results obtained with ideal candidates were reported in 1956. Again, in this present study of 100 cases, using the described surgical techniques, only ideal cases which satisfied the criteria for fenestration operation have been included.

It is unfortunate that this decision excludes cases with weak cochlear function, as some of the most impressive results obtained by mobilization of the stapes procedures are in this group. Although a remarkable improvement in hearing has been obtained following the mobilization of stapes in many patients with weak cochlear function, these cases are not represented in this statistical analysis. By accepting only ideal candidates it is possible to compare accurately results obtained by the techniques presently in use with the former procedures in which the mobilizing force was applied to the neck of the stapes. Considerable improvement has been found to exist when the latter group of cases is compared to the former.

When the mobilizing force was applied directly to the otosclerotic lesion at the footplate, an immediate improvement (one week postoperative) in hearing to above the 30 db. level was obtained in 72 per cent of cases. This figure is more than double that obtained (35 per cent) when the force was applied to the neck or head of the stapes. This difference in percentage occurred as the result of a reduced number of injuries to the crura of the stapes and to the preservation of the continuity of the entire ossicular chain. The earlier techniques depended chiefly on the strength of the crura for mobilization of the footplate, and in most cases once the crura were fractured no further manipulation was possible. The application of force directly to the point of fixation permits considerably more maneuvering and manipulation, yet preserving ossicular continuity. Although the figure of 72 per cent is encouraging, failure to obtain immediate improvement in hearing occurred in 28 per cent. In these cases the otosclerotic lesion was either too extensive to be safely mobilized; the anatomy of the oval window was unfavorable; or, accidental fracture of both crura occurred with loss of ossicular continuity. Unfavorable anatomy and pathology accounted for nine per cent of these failures, and 17 per cent did not have a satisfactory improvement in hearing because of accidental injury to the footplate or crura of the stapes. In two per cent of these cases the otosclerotic lesion also involved the round window niche.

It is significant to note from Table I that the application of the mobilizing force to the head or neck of the stapes produced an immediate improvement in 35 per cent of the cases. Only six per cent of these improved cases returned to the former level of hearing within a period of four months. In contrast to these figures are the results obtained with the present techniques. Although it was possible to obtain an immediate improvement in hearing in 72 per cent of the cases, 17 per cent returned to the preoperative level of hearing within four months. A reasonable explanation for

TABLE I.

	Force Applied to Neck of Stapes	Force Applied Directly to Footplate
Number of Cases	100	100
Immediate Improvement	35	72
Improvement Maintained:		
One Month	30	64
Four Months	29	55
One Year	24	Not available

this difference can be suggested as the cases which obtained a satisfactory improvement in hearing with the early techniques were those possessing small and possible fibrous lesions of otosclerosis. With this early procedure, little trauma to the stapedio-vestibular joint occurred in the process of mobilization, but it was possible to mobilize the stapes in only a relatively small percentage of cases.

It is reasonable to assume that all cases which would have terminated successfully by early techniques would also be successful when the mobilizing force is applied at the footplate. In this study there were many more cases from Classes II and III which required more extensive surgery at the footplate and crura before an improvement in hearing was obtained. This additional manipulation without the loss of ossicular continuity doubtlessly accounts for the higher percentage of good initial results. It appears reasonable that a larger percentage of cases would return to the preoperative level in the immediate postoperative period as mobilization of

the footplate had been achieved often by a fracture directly through a solid but active otosclerotic lesion which rarely would have occurred by the earlier techniques. The footplate techniques also create more reaction at the site of the ankylosis, possibly hastening re-fixation in some cases.

Vertigo frequently has been encountered during the operation for the mobilization of the stapes. This symptom can be induced by merely applying the aspiration tube near the round window niche, or can be caused in the process of mobilizing the stapes.

When the mobilizing force was applied to the head or neck of stapes fewer patients complained of vertigo at the time of

TABLE II.

Duration of Vertigo	Mobilization at Head or Neck	Direct Mobilization at Footplate
At Operation	10.0%	31%
Less than 24 hrs.	3.2%	10%
More than 24 hrs.	2.0%	6%

surgery, and only 2.0 per cent experienced vertigo lasting over 24 hours. Table II presents a comparison with later cases, in which the mobilizing force was applied directly to the footplate of the stapes. Although many more patients experienced vertigo at the time of surgery, few patients continued to experience vertigo after 24 hours.

These results are rather impressive, as they testify that the labyrinth is a hearty structure able to withstand surgical trauma. Vertigo as a result of shallow penetrations into the vestibule, accompanied by the loss of perilymph through a fracture in the footplate, has been observed to last several hours after surgery. Deeper penetration which may disturb the saccule or the utricle causes disturbances in equilibrium which usually terminate within a week. It also has been noted that a period of vertigo may follow an injury to the vestibular sense organs without causing a loss of hearing below the preoperative level. It has been found preferable to cover perforations of the footplate with a small piece of

Gelfoam saturated in thrombin, as this tends to reduce the postoperative vertigo. Uncovered perforations of the footplate are usually productive of more vertigo and instability of longer duration.

As experience is obtained with mobilization techniques at the footplate, vertigo is observed less frequently. In the last 50 patients of a more recent series of cases only 12 per cent have experienced vertigo due to manipulation at the time of surgery. All 50 patients were discharged from the hospital 24 hours after surgery without any evidence of vertigo. At the present time the great majority of patients do not experience vertigo during the mobilization procedure, and when vertigo does occur it is mild and disappears before the patient leaves the operating room.

COMMENTS.

Blind application of the mobilizing force to the footplate of the stapes is considered to be a dangerous and bold procedure, as penetration into the vestibule cannot be prevented by the sense of touch alone. The mobilization of the stapes must be considered strictly an external labyrinthine operation in which any instrumentation penetrating deeper than the footplate exposes the end-organs of hearing and equilibrium to trauma, serous and possibly purulent labyrinthitis. The objective of all techniques at the footplate of the stapes is to achieve mobility with absolutely no penetration into the vestibule and with the least possible surgical trauma.

The techniques described above tend to emphasize the importance of the following aspects of stapedial footplate surgery:

1. The area of the footplate which is to receive the mobilizing force must be seen directly under high magnification.
2. All manipulation is done with extreme gentleness, slowly and cautiously until the character, position and extent of the otosclerotic lesion are appreciated.
3. When the area of fixation is located the choice of mobilization procedure is made in accordance with the four classes of otosclerotic involvement presented in this study.

4. The surgeon must constantly keep in mind that in the course of mobilization of the footplate, penetrations, fenestration or dehiscence produced in this structure will only add risks which may reduce the quality of the final result.

5. The surgeon need not feel obliged to achieve mobilization of the footplate at any cost. Cases presenting very advanced otosclerosis or difficult anatomy should be recognized as unfavorable for the mobilization operation and should be spared for fenestration of the horizontal canal.

CONCLUSIONS.

The use of the surgical microscope adds considerable safety to the mobilization of the stapes operation, as it permits direct visualization of the otosclerotic involvement, better control of the forces required for mobilization and precise notation of the changes produced by the applied forces.

It is possible to differentiate four classes of otosclerotic involvement on an anatomic and pathologic basis which can serve as a guide for the choice of a suitable mobilization technique. In order to apply this classification to any case, careful study is necessary before mobilization is attempted. This pre-mobilization evaluation, together with a suitable mobilization technique, has been responsible in producing a high percentage of good results with few complications.

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HISTOLOGICALLY MALIGNANT GLOMUS JUGULARE TUMOR. (Case Report.)

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In the decade since Rosenwasser first correlated the clinical findings of glomus jugulare tumor with Guild's previously published anatomical description of the glomus jugulare bodies, numerous examples of this neoplasm have been reported. Interest has not been limited to the otological literature alone, as excellent reports have also appeared in the journals of pathology and neuro-surgery.

There has been general agreement among authors that these neoplasms should be classified as histologically benign lesions (see Fig. 1). Their clinical behavior with the typical history of slowly developing symptoms, often over a period of years, would substantiate this assumption; however, their tendency to invade adjacent vital structures with the development of vascular or neurologic involvement threatening the patient's life, has led some authors to describe these lesions as histologically benign, but locally malignant by position. Metastatic spread from a primary glomus jugulare tumor has been reported only infrequently.^{1,2,3,4}

This case report of a patient with a glomus jugulare tumor described as histologically malignant is added to the literature because of the infrequency of such a lesion.

CASE REPORT.

This 49-year-old white male was first seen on February 10, 1956, with a chief complaint of bleeding from his left ear, of about one week's duration. The present illness revealed that he had noticed increasing hearing loss

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in the left ear for the past four to five months. About one week before the patient was first seen, he described the left ear as feeling full. It was at this time that he put his finger to the left ear and caused bleeding. He immediately consulted a physician who visualized a tumor mass in the left external auditory canal and took a specimen of the mass for histological examination. The patient denied any previous history of pain in the ear and was not aware of any discharge from the ear. Two days before he was seen he noticed a numb sensation over the left side of his face, and found that he could not completely close his left eye nor could he move the left corner of his mouth normally.

Physical examination at this time revealed a middle-aged man with an obvious facial paralysis. The paralysis was peripheral in type and not

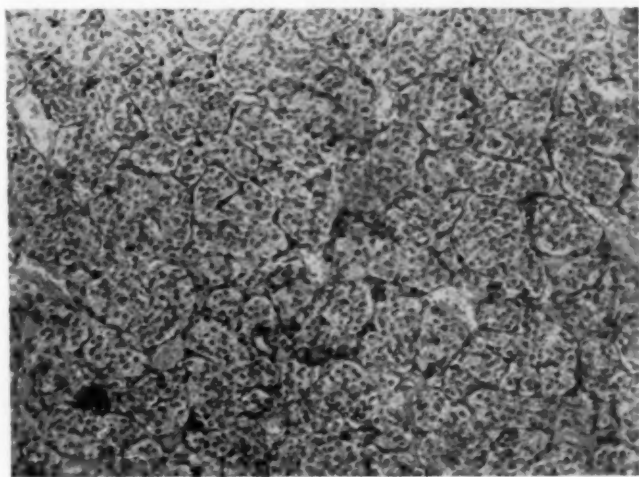


Fig. 1. A representative section from a histologically benign glomus jugulare tumor showing the regular arrangement of the cells and the lack of mitotic activity.

complete, as there was still slight motion at the corner of the mouth on the left. The other positive findings were limited to the left ear. There was a tumor mass occupying the inner half of the left external auditory canal, and the tympanic membrane could not be visualized. Roentgenological examination of the mastoids revealed minimal sclerosis of the cells of the left mastoid; however, no other abnormality of the left temporal bone could be identified. The Weber test was strongly lateralized to the left. Pure tone audiometry revealed responses within normal limits for the right ear. Losses averaging 40 db. in the speech frequencies by air conduction were obtained in the left ear with good preservation of bone conduction. Speech testing revealed a speech reception threshold of 40 db. in the left ear with a discrimination score of 88 per cent. Histological examination of the tissue which had been removed previously was reported to show a very highly vascular malignant tumor with cells having

peri-vascular arrangement consistent with malignant glomus jugulare tumor (see Fig. 2).

On February 14, 1956, left radical mastoidectomy was carried out. The following interesting findings were noted at surgery:

1. There was already tumor involvement of the bone of the posterior superior canal wall with tumor tissue presenting through the bone.

2. Cells of the superior half of the mastoid were diseased and filled with tumor tissue while the cells of the lower half of the mastoid including the tip were clear.

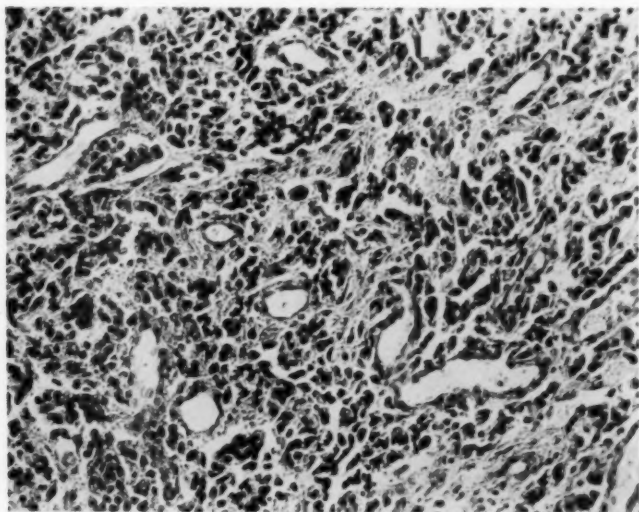


Fig. 2. A representative section of the main tumor mass showing the lack of regular cellular arrangement, the lack of polarity of the cells, and the increase in mitotic activity.

3. The lateral sinus was pathologically exposed and there was tumor tissue on the wall of the sinus.

4. The dura was exposed over the tegmen antri for an area approximately 2.5 cm. x 1.5 cm., and this dura was involved with tumor tissue.

5. When the main mass of tumor was removed from the tympanum along with the remnants of the drum, the stapes was visualized still present in the oval window with tumor tissue surrounding it.

6. Anterior to the labyrinth, the removal of tumor tissue furnished a lead into the petrous pyramid. The entire pyramid was filled with tumor tissue, and the superior wall was gone leaving the dura in the area completely exposed.

7. The facial nerve was exposed in the anterior half of its intratympanic segment.

At the completion of surgery, the cavity was relatively clean, but it was obviously realized that residual tumor had been left.

Post-operatively, the patient did well, and the facial paresis recovered in four days. On February 24th, he was started on external irradiation therapy to the left temporal bone. He received approximately 3,000 roentgens over a period of three weeks.

During the period of irradiation, his cavity seemed to heal surprisingly well; however, by the time his therapy was completed a very obvious

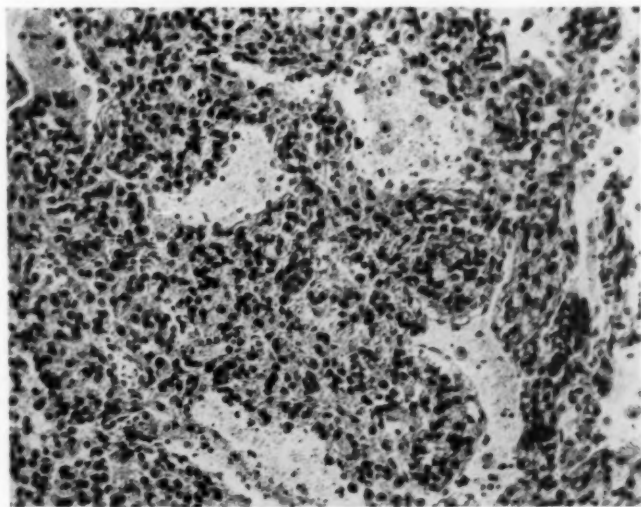


Fig. 3. A representative section of the pulmonary metastases showing similar tumor tissue with a small amount of normal lung tissue still identifiable.

drooping of his dura had developed. Posteriorly in the bowl the dura rested almost on the facial ridge. On May 2, 1956, the patient had a convulsion lasting a few minutes. On May 28, 1956, he had a sudden hemorrhage from his left ear. On June 8, 1956, a return of tumor tissue in the region of the tympanum was noted. On June 12 an anterior cervical node was palpated just behind the angle of the mandible. Chest X-rays at this time revealed multiple metastases throughout both lung fields. His downward course following this was very rapid with increase in the involvement in the neck, the development of aphasia, and finally paralysis of the right arm and leg. The patient expired July 17th, approximately five months after he was first seen.

Post-mortem examination was carried out and revealed the following:

1. The lungs revealed multiple foci of metastatic tumor (see Fig. 3).

2. The left temporal bone and brain revealed highly anaplastic and vascular malignancy with marked infiltrative tendencies. There was extension throughout the petrous portion of temporal bone with dural breakthrough. Direct extension to the brain in the left temporal lobe and throughout the subarachnoid space in the posterior fossa was present.

The pathological diagnosis was:

1. Malignant left glomus jugulare tumor with pulmonary metastasis.

2. Diffuse infiltration of the left temporal bone with mastoid replacement.

3. Mastoiditis and dural invasion with meningitis and direct cerebral extension.

The summary of the pathologist was as follows: "This rather unusual diagnosis is based on the combined pathological and clinical findings. Pathologically, the topography, histology, and cytology are entirely consistent with what has been described. Clinically, the localization and progression of the disease tend to confirm the findings of a primary tumor of the left temporal bone with a highly malignant potential."

DISCUSSION.

It would appear that the clinical course of this patient substantiates the histological diagnosis of a malignant lesion. The rapid downhill course described above is not the typical story of a glomus jugulare tumor. We have previously seen patients with equally as much or more tumor involvement who have survived without serious difficulty for a period of years, some of them with little treatment. The rapid return of the lesion after surgery and its spread both locally and to distant sites are far more characteristic of a highly anaplastic squamous cell carcinoma of the middle ear.

The above case history should again emphasize the fact that although these lesions are usually considered to be benign, malignant variants can and do occur. With the extensive involvement which was present in this case, it was obvious that complete surgical extirpation could not be achieved. Irradiation therapy did not seem to offer any additional help. Whether newer techniques with irradiation therapy will offer more promising results in the future, only time can tell. At this time, however, we feel we must concede that the outlook with a malignant form of glomus jugulare tumor remains pessimistic.

SUMMARY.

One case of histologically proven malignant glomus jugulare tumor has been presented.

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COURS DE TECHNIQUE CHIRURGICALS.

The Faculty of Medicine of Paris, Chaire de Clinique Oto-Rhino-Laryngologique under the direction of Professor A. Aubin will present a course in the Surgery of Deafness, June 9-14, 1958.

CONTROVERSIAL ASPECTS OF THE TREATMENT OF LARYNGEAL KERATOSIS.*†

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This paper sets forth some personal experiences in the treatment of recurrent severe laryngeal keratosis, reviews the reports of others, and is written to focus attention on the problem of the treatment of severe recurrent keratosis or leukoplakia of the vocal cords. In it, no attempt is made to review a large series of cases, or to draw statistical conclusions; the discussion does not pertain to mild nor non-recurrent keratosis. The problem is presented from the standpoint of one clinician who is troubled by a difficult problem, of serious portent to his patients, for which only an incomplete solution exists. Case summaries illustrate some of the various clinical sequences encountered, *i.e.*, (a) Keratosis with quick metamorphosis into carcinoma leading to laryngectomy (*Case 1*); (b) Keratosis with long interval before becoming invasive and needing laryngectomy (*Case 2*); (c) Keratosis observed for many years, treated by radiation and local excision, and after many years still apparently controlled (*Case 4*).

A recent experience in which I recommended irradiation therapy for a man having recurrent laryngeal keratosis, and the local radiologist refused to treat him, has served to make me examine carefully the various aspects and ramifications of this subject. A few months ago, I removed a large keratosis from the larynx of a 74-year-old man (*Case 3*), five years after removing a similar keratosis from his larynx. The patient weighed 260 pounds, was not a good surgical candidate, and I asked his family doctor, at a considerable

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distance from Minneapolis, to arrange for radiation therapy near his home. I explained to the local physician that the patient's lesion was precancerous, and that I hoped that radiation would prevent later development of a cancer. The local physician took the matter up with the local radiologist and others, and the collective decision was that inasmuch as the

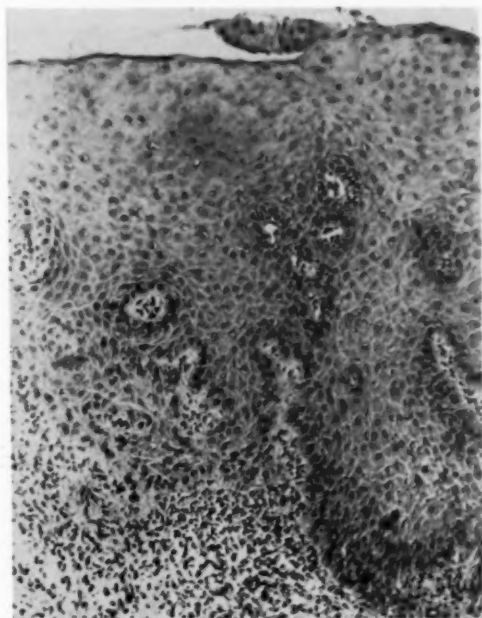


Fig. 1. Case 1. Dec. 7, 1949. Biopsy of right vocal cord interpreted as keratosis, but subsequently re-evaluated as indicating carcinoma.

lesion was not malignant, it should not be radiated. I wondered whether I had been wrong in recommending radiation for a non-cancerous lesion, and consulted with my colleagues and read what I could find on the subject; then the patient was brought to Minneapolis, where he was subjected to a full cancericidal dose of deep X-ray therapy, fractionally administered, at the University of Minnesota Hospitals. Radiation

was prescribed here partly because of the experiences outlined below:

In 1949 and 1950, I removed keratotic masses from the larynx of a 59-year-old man (*Case 1*). In 1951, a biopsy showed low grade malignancy and the larynx was removed. (*Case 1*, see Figs. 1, 2 and 3). This lesion progressed from

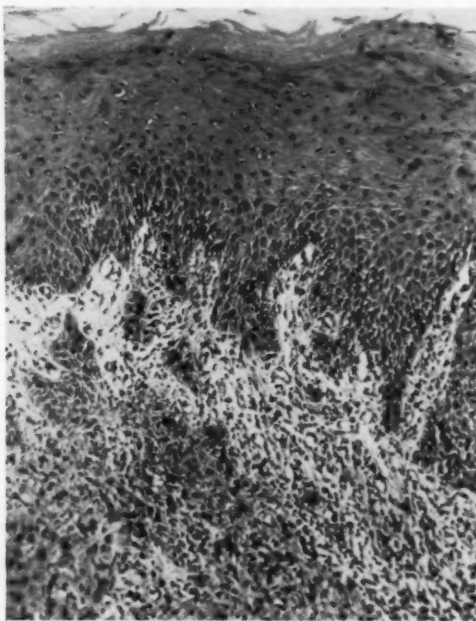


Fig. 2. *Case 1*. Jan. 11, 1950. Biopsy of right vocal cord and misinterpreted as was Fig. 1.

keratosis to carcinoma in two years. This is somewhat similar to a case cited by Jackson,¹ and is an unhappy sequence which must have been encountered by many other physicians.

Shortly after this unpleasant experience another patient (*Case 2*) with an extensive laryngeal keratosis, came to me for advice. This man had been told elsewhere to have a

laryngectomy on the basis of a frozen section interpreted as indicating cancer. My biopsy showed no cancer in the opinion of several competent pathologists (see Fig. 4). I thought about the patient described above, whose keratosis I had removed repeatedly and who had developed cancer requiring laryngectomy. It seemed to me that there must be a better



Fig. 3. Case 1. Sept., 1950. Biopsy of right vocal cord, misinterpreted as in Figs. 1 and 2, but re-evaluated as indicating carcinoma and followed by laryngectomy with apparent cure.

way to treat this condition than simply to remove keratoses repeatedly. I thought that any patient who developed vocal cord cancer after precancerous lesions had been excised from his cords repeatedly, would surely have a right to wonder whether his doctor had treated him in the most effective manner. It seemed that the doctor should critically examine his therapeutic method.

Schall² had shown that radiation produced five-year cures in 92 per cent of small cordal epitheliomas; however, I knew that radiation reduced the viability of tissues. If surgery was needed later, this certainly would have to be taken into account. My memory of pharyngostomes, shown to me by Dr. Walter Work at The Veterans' Hospital in San Francisco,

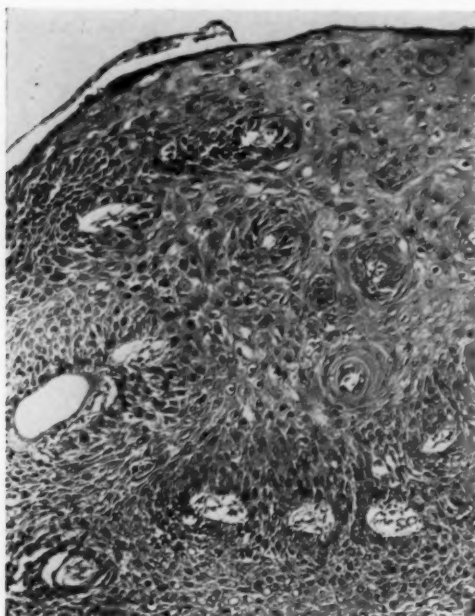


Fig. 4. Case 2. July 17, 1952. Biopsy of right vocal cord interpreted as indication keratosis and no carcinoma. Cords then stripped of keratosis (July 21, 1952). Patient subjected to repeated biopsies and X-ray therapy to larynx. In 1957 biopsy showed carcinoma, and laryngectomy was done.

was vivid. These gaping holes had resulted from poor wound healing in patients having laryngectomy after radiation had failed to cure their laryngeal cancers.

In considering Case 2, I telephoned to one of the country's most eminent laryngologists in another city and discussed the problem with him. He said that he had been through the

same series of experiences, and had used X-ray therapy to treat patients with recurrent laryngeal keratosis in a small number of cases with seemingly good results; therefore the patient who had been advised elsewhere to have a laryngectomy (Case 2) was treated by stripping his cords completely of keratosis, and the larynx was radiated with deep



Fig. 5. Case 3. July, 1952. Biopsy of left cord in 69-year-old male, interpreted as keratosis. See Fig. 6 for biopsy of same case five years later.

X-ray. The keratosis seemed to regress, and in 1955, three years after the first biopsy, a specimen was presented at the University of Minnesota's pathologists' conference. This conference is attended by pathologists from some 20 hospitals in Minneapolis and St. Paul. These men could see no difference in slides made in 1955 and those in 1952. They did not rule out a diagnosis of pre-invasive carcinoma, but

thought one could classify the lesion as keratosis or leukoplakia with equal accuracy.

From 1955 to 1957 repeated biopsies showed no change, but in 1957 an invasive carcinoma of the vocal cord was diagnosed and the larynx removed. The histories of Cases 1, 2, 3 and 4 are summarized at the end of the paper and photomicrographs of their laryngeal biopsies are presented there (see Figs. 1 through 9).

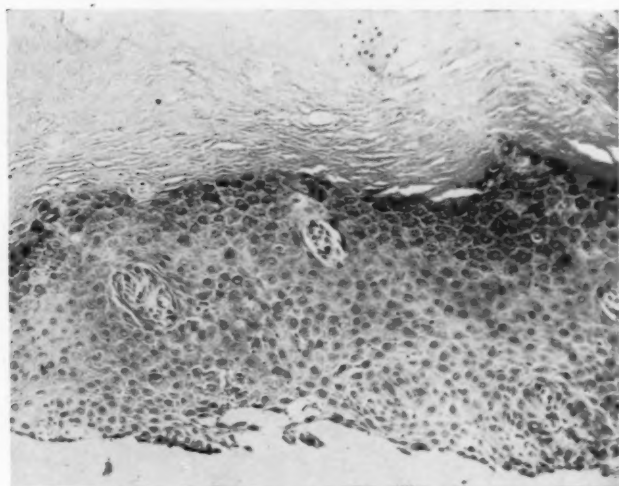


Fig. 6. Case 3. April 25, 1957. Biopsy of right cord for recurrence of keratosis illustrated in Fig. 5. Locally excised and later treated by full cancericidal dose of deep X-ray.

In treating leukoplakia or keratosis or carcinoma *in situ* of the vocal cords, the laryngologist is dependent upon the pathologist's interpretation of the biopsy and his general attitude as well as his nomenclature and classification. In Case 1 cited above, the original reports by the pathologist examining biopsy specimens indicated no invasive tendency on the part of the tumor; after the larynx had been removed for cancer, re-examination of the original slides by another pathologist showed that the invasive tendency could occasionally be dem-

onstrated (see Fig. 1). It is easy for the pathologist to tell frankly invasive cells from frankly non-invasive cells in epithelial biopsies, but to be sure when the lesser degrees of invasiveness appear is difficult. The sections examined cannot represent the entire specimen, and the pathologist's philosophy, astuteness, nomenclature and breadth of experience all influence his report.

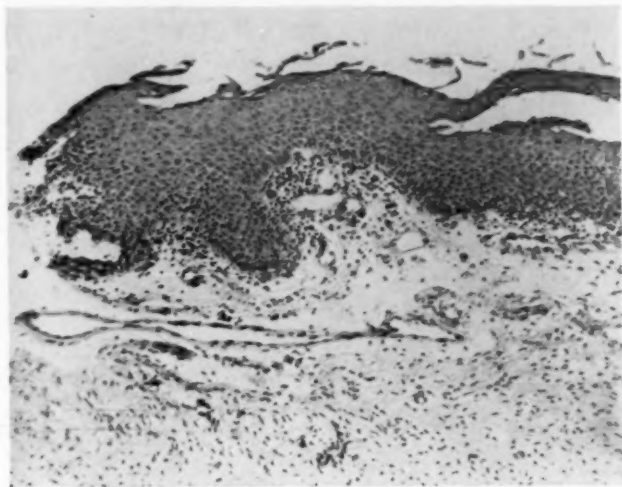


Fig. 7. Case 4. 1949. Biopsy of right and left vocal cords yielded tissue of this type interpreted as keratosis. Deep X-ray therapy to larynx in 1952. Recurrences thereafter were limited to one small area of left cord. See Figs. 8 and 9 for tissue taken seven and eight years later.

Park and Lees⁵ say that the pathologist, when he is at all uncertain, must play safe and make a "pragmatic" diagnosis of malignancy. They cite urologic pathologists who say that intramucosal carcinoma of the prostate is present in 12 to 40 per cent of males after the age of 50 years despite the fact that the death rate from this disease is only about 1 per cent of the deaths of all males. This example illustrates the present discrepancy between the morphologic definition of carcinoma and some clinical realities.

The terms leukoplakia, carcinoma *in situ*, incipient carcinoma, preinvasive carcinoma, intramucosal carcinoma and superficial non-invasive intra-epithelial carcinoma are encountered in a discussion by Hertig and Younge⁶ relating to carcinoma of the uterine cervix. These authors say that the concept has been advanced that carcinoma *in situ* in an early

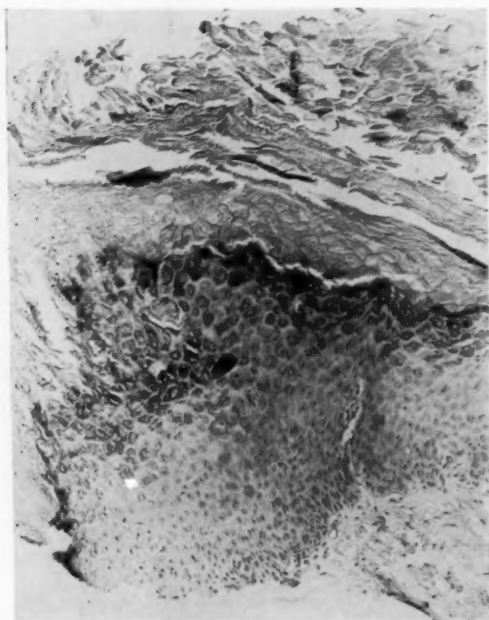


Fig. 8. Case 4. 1956. Similar to Fig. 7.

stage of invasive carcinoma, and will become invasive cancer if one only waits long enough. Cases are cited in which the metamorphosis occurred in 11 months to 13 years. The authors admit the possibility that invasion may have been present at the time of the original biopsy, but point out that the entire cervix would have to be sectioned to decide this. Thus they say "the absolute scientific proof that the *in situ* stage of carcinoma precedes the invasive stage may never be

forthcoming, since to rule out early invasion one must have the entire cervix, but to prove the ultimate invasiveness of the process the cervix must be left in."

Jones⁷ described 740 patients having carcinoma of the uterine cervix. Of these it was found that 13 had happened to have biopsies made one to 17 years earlier, all interpreted

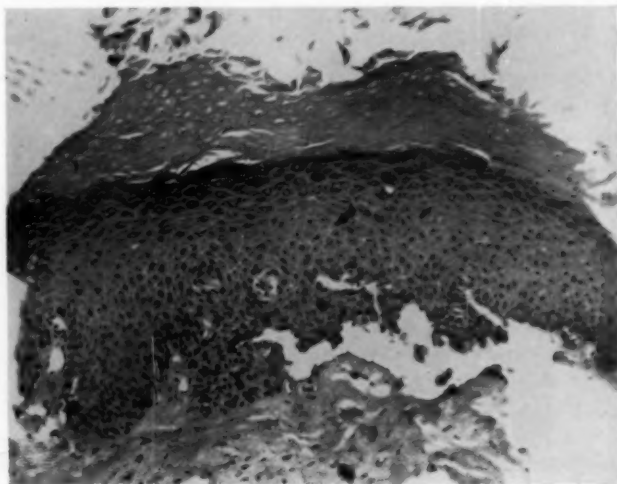


Fig. 9. Case 4. 1957. Similar to Figs. 7 and 8. Locally removed and base cauterized with electrocoagulation.

as being non-malignant. In 12 of the 13 re-examinations of the original specimens showed squamous epithelium, and in 11 of the 12 intraepithelial carcinoma was present. Jones said, "We therefore came to the conclusion that most individuals with clinical carcinoma of the cervix have a preceding lesion which we call 'intraepithelial carcinoma'."

Putney and O'Keefe⁸ in 1953 reviewed 125 cases of laryngeal keratosis, and said that keratosis of the larynx was a premalignant lesion in a definite percentage of cases when it persists. In their cases carcinoma supervened in less than six months after the first biopsy in six cases, and only after

eight to ten years in three cases; 41 never showed malignant degeneration. Putney and O'Keefe emphasize the need for repeated histologic examination of keratotic lesions of the vocal cords for accurate diagnosis. Putney⁴ in 1955 commented further on these cases and others. He said that benign histologic appearance is not proof that the lesion will remain benign. He thought that management is not simple and includes forceps removal, X-ray therapy, excision by thyrotomy approach, irradiation by suspension laryngoscopy and electro-surgical removal of the lesion.

Miller and Fisher⁵ feel that carcinoma *in situ* in the larynx is an early pre-invasive stage of intra-epithelial carcinoma. In their series, deep X-ray radiation was given to ten patients, the superficial lesion being stripped away in seven. In seven of the ten cases, the lesion appeared to be controlled five-and-a-half to 53 months after treatment. Recurrences after six and 16 months respectively in two patients were treated by endolaryngeal removal of the lesions without further recurrence. Two patients were treated by laryngofissure only and were still controlled 31 and 16 months later. Stripping alone was done in one patient whose larynx remained normal for 18 months. This study showed that carcinoma *in situ* of the larynx can be treated by X-ray but may recur.

Comment: The laryngologist treating keratosis of the vocal cord faces a complex problem. Perhaps the concept that keratosis or carcinoma *in situ* will surely become malignant if allowed to develop unchanged is true for many cases. If so, what can be done to interrupt this metamorphosis? Aside from various forms of mechanical treatment, irradiation is the most important agent available. Unfortunately, no chemical agents seem to exist at this time which upset the change of cells from the normal to the malignant state. Parenthetically, I may say here that I once treated several laryngeal squamous cancers in males with female hormones, because of the predilection of this disease for males, with no discernible result. The question of the influence of radiation therapy on *in situ* carcinoma is important. The fundamental question is: can radiation therapy influence potentially invasive epithelial cells, already morphologically different from normal

but not yet different enough to be invasive, so that their invasive tendencies will be destroyed? Case 2, cited above, had the use of his larynx for six years after radiation but developed cancer despite radiation. Whether his cell metamorphosis was slowed down by the radiation is a matter of opinion.

The sum total of published experience on this subject appears to be insufficient to permit an absolute conclusion at this time; however, if real vocal cord cancers can sometimes be cured by radiation, when they are not far advanced (Schall²), does it not seem possible that recurrent leukoplakia may be discouraged in its progress toward invasive carcinoma by radiation therapy? It is reasonable to hope that in some cases malignant metamorphosis will cease or be slowed down. The purists will argue that those cases which do not become malignant were not really potentially malignant anyhow, and nobody can say that they are wrong. Use of radiation therapy for treatment of recurrent severe laryngeal keratosis at present is empirical. In severe recurrent keratosis it seems to me to be better than simple mechanical removal alone; but in cases of localized keratosis, not superior to local excision and electrocoagulation. The treatment of laryngeal keratosis must be individualized in each case, and an open-minded attitude must be maintained by the clinician, to permit the use of several different therapeutic methods in any one case. Radiation may be used in conjunction with local excision and/or electrocoagulation.

It appears that severe recurrent laryngeal keratosis, like uterine cervical keratosis, is probably a disease extending over a period of ten or more years, in which progress from non-invasive to invasive is inevitable. Frequent inspection of the larynx and repeated biopsies to detect early change from non-invasive type to invasive are essential to the management of the disease.

ABSTRACTS OF CASES.

Case 1. A.D., No. 6480, aged 59, was first examined because of hoarseness in December, 1949. His right vocal cord was found to be completely covered with glistening, white, piled up epithelium. Biopsy Dec. 7, 1949, was reported as benign keratosis (see Fig. 1). On Jan. 11, 1950, 35 pieces were stripped from cord (see Fig. 2). In September, 1950, he

had recurrence of keratosis of right cord. Seventeen pieces of tissue were removed from right cord and were reported as being keratosis and "no definite malignancy seen". Consultation with other pathologists indicated that malignancy was present (see Fig. 3), and review of sections of previous biopsies showed that invasive tendency had probably been present all the time. Laryngectomy was done on Oct. 13, 1950, with apparent cure when patient was last examined in 1953.

Case 2. E.D.S., No. 11313, first examined in July, 1952, because of hoarseness. He had been advised on basis of frozen section to have laryngectomy. Pearly white lesions covered all of right cord and one-third of left cord. On July 17, 1952, biopsy (see Fig. 4), no malignancy was found. On July 21, 1952, thorough stripping of cord was done. Patient was subjected to deep X-ray therapy elsewhere, probably receiving less than a cancericidal dose because he had previous radiation for another condition in his mandible. Biopsies made in 1952 were called invasive, but University of Minnesota pathologists thought they were non-invasive. Repeated biopsies were made elsewhere, and in 1957 invasive tendencies were definitely found, and laryngectomy was done elsewhere.

Case 3. F.E., No. 11347, aged 69, weight 260 lbs., was first examined on July 19, 1952, because of hoarseness, and was found to have a deep red lesion in the middle third of his left cord. This was excised by direct laryngoscopy on July 21, 1952, in the belief that it was cancer. Biopsy showed only keratosis (see Fig. 5). The patient was instructed to return in two months. He returned in five years! The lesion had recurred and had a red base and a keratotic grey surface, but the cord still moved freely. On April 25, 1957, local removal was done again with the mental reservation that this was cancer, and again the pathologic diagnosis was keratosis (see Fig. 6). Radiation was recommended (Patient aged 74, weight 260 lbs.), and the radiotherapist in the patient's home community refused to administer it on the ground that the lesion was non-malignant. Patient returned to Minneapolis and full cancericidal dose of Gamma radiation was fractionally administered to the larynx in October, 1957. Obviously the long term result cannot be assessed at this time.

Case 4. C.W.C., No. 875, aged 49, was first examined in 1949 because of hoarseness. Despite four weeks of vocal rest and cessation of work, hoarseness persisted. Gray masses partially covered each vocal cord. These were biopsied (see Fig. 7) and were keratosis. The lesions were stripped off but recurred in 1950 and grew larger, so that in 1952 deep X-ray therapy, in dosage just under a cancericidal dose, was administered to the larynx. In 1953, a tiny keratotic plicae reappeared on the left cord. This was observed through 1954 and 1955; biopsied in 1956 (see Fig. 8), and in 1957 was removed (see Fig. 9). Histologically it was still benign keratosis. Electrocoagulation of the base at the last removal may prevent recurrence, but has reduced the quality of the voice. Prior to radiation the keratoses occurred all over the vocal cords. After radiation, recurrence was limited to one small area on one cord. Obviously this man may still develop laryngeal cancer, but it seems quite likely that he would have developed it long ago without treatment.

SUMMARY.

Borderline malignant lesions of the larynx are discussed from the standpoints of personal experience and after review of pertinent papers. The concept that the condition variously designated as intra-epithelial carcinoma, or keratosis, or carci-

noma *in situ* et al., progresses rather relentlessly from being non-invasive to being invasive over a period up to ten or more years is examined, and at least partially accepted as appearing to delineate the course of certain laryngeal lesions. The similarity of behavior of laryngeal lesions and those of the uterine cervix is taken into account. The possibility that Gamma radiation may be used to slow down or interrupt the progressive change of the tumor cells from non-invasive to invasive is discussed. It appears that the use of such radiation, in conjunction with mechanical removal of the lesion may have value but is empirical, and its exact degree of usefulness is impossible to assess. If one chooses to use radiation therapy he must take into account the possibility that wound healing in subsequent surgery may be interfered with to a substantial degree.

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ATTICOMASTOIDECTOMY IN CHRONIC OTITIS MEDIA WITH CENTRAL PERFORATION.*†

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This discussion concerns itself with those patients who have persistent aural discharge due to chronic suppurative otitis media in the presence of a central perforation.

These patients experience discomfort mainly of a fetid discharge; however, they are commonly considered "safe" insofar as intracranial complications are concerned. These standards of safety were established early in the history of otologic surgery, and were balanced against the known incidence of surgical complications of that period. Present day otologic skills in microsurgery of the temporal bone and antibiotic therapy have yielded such a high degree of success that it seems advisable to re-evaluate cases of chronic otitis media with central perforation as to their relative innocence.

It should be clearly understood that all methods of non-surgical management should first be exhausted. The majority of these patients will respond to local and parenteral antibiotic therapy, as well as the time honored treatment of granulation tissue by excision and/or cauterization. Adenoidectomy, when indicated, and treatment of underlying sinusitis and nasopharyngitis, whether allergic or inflammatory, particularly in younger patients, are often effective adjunctive treatment.

There remains a relatively small number of patients who in spite of all nonsurgical measures, continue to suppurate, perhaps due to irreversible mastoid and attic pathology. In

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addition, the so-called "safety" of chronic suppurative otitis media with a central perforation refers to the only occasional presence of bone erosion by cholesteatoma in central perforation. Otolologists have all observed lateral sinus phlebitis, extradural abscess, facial paralysis and even brain abscess and fulminating meningitis develop after years of quiescent suppuration as the result of an acute exacerbation in the absence of cholesteatoma; also despite its low incidence, cholesteatoma does occur in a small number of such cases. It may be produced by metaplasia, or a previous attic perforation may heal and with the very next acute otitis media, a permanent central perforation with chronic suppuration may result, with cholesteatoma as a surprise surgical finding. Because of the potential dangers of continued suppuration, and because of the socioeconomic disadvantage of continuous and malodorous discharge, we have performed surgical treatment in many such patients.

It is of interest to note that no comparable instance of a complacent attitude to chronic suppurative disease exists for lesions elsewhere in the body, especially when one considers the vital centers involved in the temporal bone area.

In such patients, we have over the past 23 years, attempted radical mastoidectomy or mastoidotympanectomy. While this procedure was successful in controlling the disease, the hearing response was often poor. It must be borne in mind that the ossicular chain in these patients was usually intact. This was in contrast to the usual improvement of hearing after mastoidotympanectomy and grafting in patients who had extensive polyposis, ossicular erosion and cholesteatoma.

During this period, we also attempted atticomastoidectomy with a fenestration type flap, or the Bondy type of modified radical mastoidectomy. The hearing result and cessation of discharge were gratifying, but the care of the mastoid cavity became a problem. When we considered the small degree of mesotympanic and hypotympanic bone necrosis, and since many of these patients are young, and because of the experience of periossicular microsurgery gained from fenestration operations, we, therefore, decided to carry out complete mas-

toideotomy, including atticotomy, with careful skeletonization of the labyrinth, dural plate and ossicular chain. This procedure is essentially an extensive simple mastoidectomy with addition of a complete atticotomy, preserving the posterior and superior bony canal wall. It is performed endaurally so as to provide continuous access to the antrum for dusting with

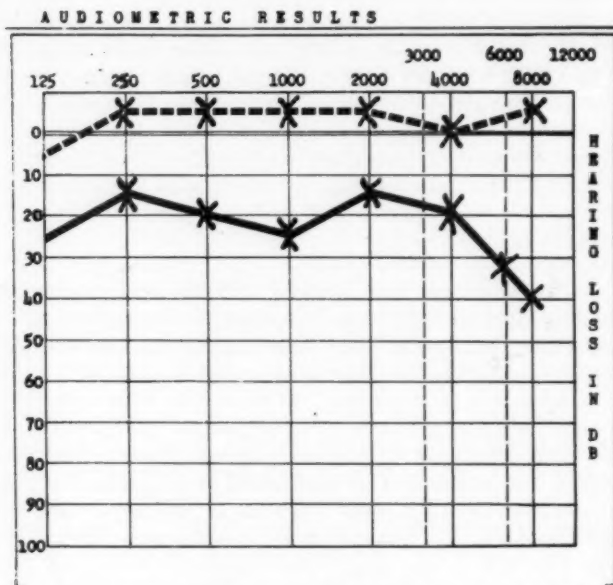


Fig. 1. M.A. female, Age 8, Date of Surgery 7/30/53.
Solid lines indicate preoperative hearing. Dotted lines
indicate postoperative hearing.

antibiotic powder postoperatively. If granulations of the hypotympanum and peritubal area are present, a 2 mm. polishing bur is spun through the central perforation inferiorly and anteriorly toward the Eustachian tube. At the time of surgery, the cavity is dusted with surgical aureomycin powder and the endaural incision closed with a polyethylene drain which leads to the antrum. The drain is replaced

weekly for 6 to 12 weeks after dusting of the cavity with antibiotic powder. This is continued until the wound heals by granulations which form from the antrum to the endaural incision. We have chosen to present nine out of 24 cases. They are considered representative and describe the procedure and its results.

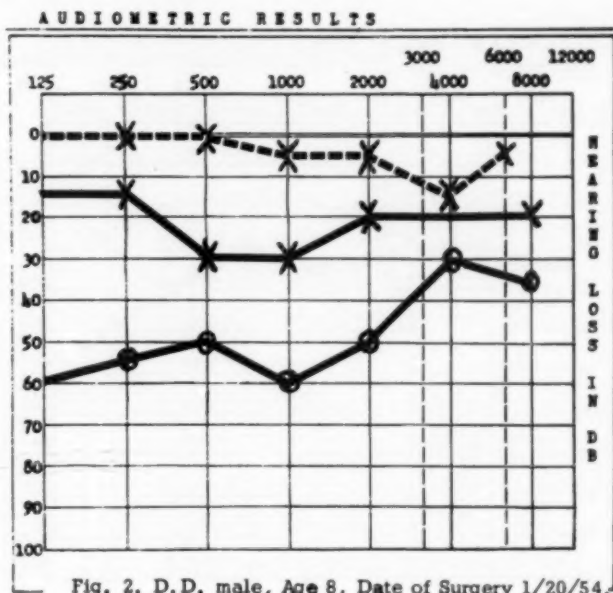


Fig. 2. D.D. male, Age 8, Date of Surgery 1/20/54.

Case 1.—M.A., Female, age eight years, first seen in November, 1952, with intermittent discharge from both ears for the past two years. The family had noted some hearing loss. T&A had been recently performed. Examination showed severely retracted drums and evidence of secretory catarrh. The child was treated repeatedly with antibiotics for recurrent episodes of pain and drainage. She underwent X-ray therapy of the nasopharynx and a second adenoidectomy. The right ear responded to these treatments and the hearing improved, but the left ear developed a posterior and superior perforation with persistent discharge and averaged a 20 db. loss.

July 30, 1953, an atticomastoidectomy was performed. The mastoid showed mixed sclerosis and patches of granulation tissue with small areas of bone necrosis. Under magnification, granulation tissue was re-

moved from the attic and the ossicles were exposed and thoroughly cleaned.

In September, 1953, healing was complete and hearing had returned to normal, and has remained well (Audiogram, see Fig. 1).

Case 2.—D. D., Male, age eight years, first seen in October, 1953, with a history of bilateral ear infection at two months of age; treated successfully with paracentesis and penicillin. Three years prior to the first visit, a recurrence of the infection had been again treated with penicillin followed by T&A, but the left ear had continued draining intermittently

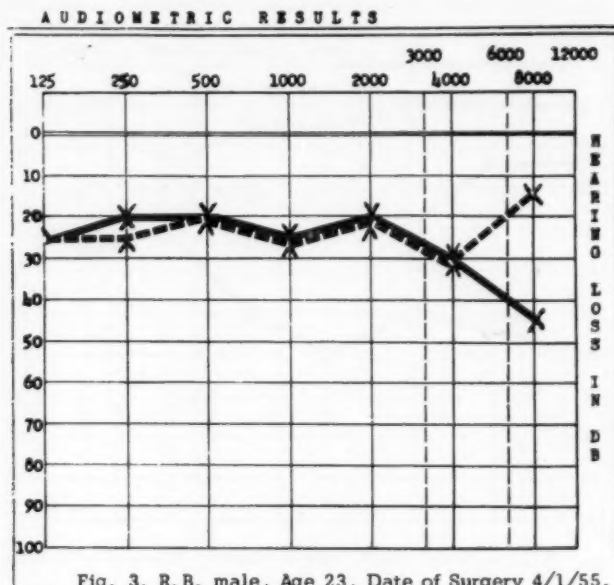


Fig. 3. R. B. male, Age 23, Date of Surgery 4/1/55.

ever since. Examination showed a posterior central perforation of the left tympanic membrane, with a protruding granuloma and purulent discharge. The perforation healed after removal of the granuloma and local dusting with aureomycin powder, but the infection recurred in December, 1953; again it responded well with local therapy, only to flare up once more in January, 1954. X-rays showed a slightly underdeveloped left mastoid with patchy sclerosis and retrofacial and tip cells. Hearing averaged 25 db. loss in that ear. Restoration of hearing was most important in this ear because of a congenital conductive loss of 50 db. in the right ear.

On January 20, 1954, an atticomastoidectomy was performed. The mastoid showed mixed sclerosis and cells were found only in the mastoid

tip and the retrofacial area. These were filled with granulation tissue. The attic was exposed and granulation tissue was dissected from the ossicles. At the end of February, 1954, the ear was healed and the hearing was practically normal by March, 1954. The perforation closed spontaneously (Audiogram, see Fig. 2).

Case 3.—R. B., Male, age 23, first seen in March, 1955, complaining of intermittent discharge from the left ear since childhood. Examination showed a posterior central perforation with purulent drainage on the left side. The patient had recently been treated extensively with anti-

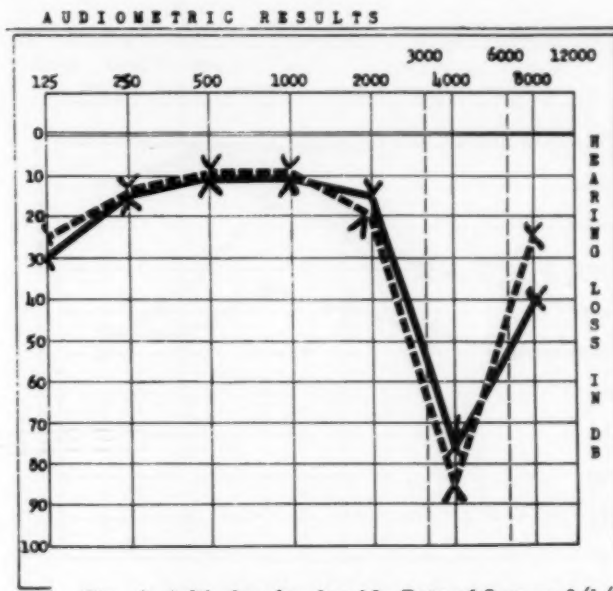


Fig. 4. A. W. female, Age 19, Date of Surgery 9/1/55.

biotics; with each course of therapy the perforation would close and secretory otitis would ensue. Paracentesis would be followed by a persistent discharge; again he was treated with antibiotics. When this process had occurred four times, with a hearing loss fluctuating around 30 to 35 db., surgery was advised; X-rays of the mastoid revealed a marked disturbance of pneumatization; one could see several medium sized clouded cells with thickened walls.

On March 29, 1955, an atticomastoidectomy was performed. There was necrosis of the mastoid cells and pus escaped under pressure. Extensive granulations were found in the attic; a periossicular dissection was carried out; the tympanic perforation was freshened with a 1 mm.

polishing bur and closed with the triangular skinflap obtained from the endaural incision.

May 27, 1955, the drain was permanently removed; in June the ear was dry and healed; the hearing averages 20 db. (Audiogram, see Fig. 3).

Case 4.—A. W., Female, age 19, first seen in August, 1955, complaining of intermittent pain and discharge from the left ear for several years. Examination showed a granuloma on the posterior margin of the left drum, with a purulent discharge and desquamative debris; several weeks of local and parenteral antibiotic care did not affect the persistent purulent discharge.

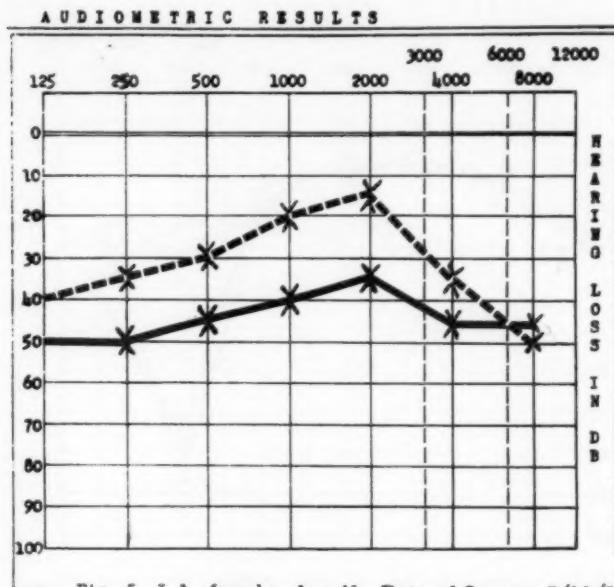


Fig. 5. J.A. female, Age 41, Date of Surgery 7/10/56.

X-rays revealed a sclerotic mastoid; no isolated cells could be outlined; her hearing averaged a 10 db. loss for the speech range in this ear.

Atticomastoidectomy was performed Sept. 1, 1955. The ossicles were freed from a mass of granulations and left undisturbed. The hypotympanum and peritubal granulations were removed with a polishing bur through the central perforation; by the end of October the ear was dry, but the perforation was still present. In August, 1956, the patient developed an acute infection of the operated ear following swimming. The infection subsided under tetracycline therapy and the ear has been dry since. Her hearing has returned to the preoperative level; the perforation has persisted (Audiogram, see Fig. 4).

Case 5.—J. A., Female, age 41, first seen in June, 1956, with a history of repeated ear infections on the left side since 1927; the ear had been draining constantly for the past year. The patient was complaining of headaches and tinnitus; repeated courses of antibiotics failed to cure the disease and her hearing loss averaged 40 db. in the left ear.

X-rays of the mastoid showed a sclerosing mastoid bone and a few large cloudy perisinus cells with thickened walls.

An atticomastoidectomy was performed on July 10, 1956. Chronic mastoiditis, granulations of the attic and a pea-sized cholesteatoma of

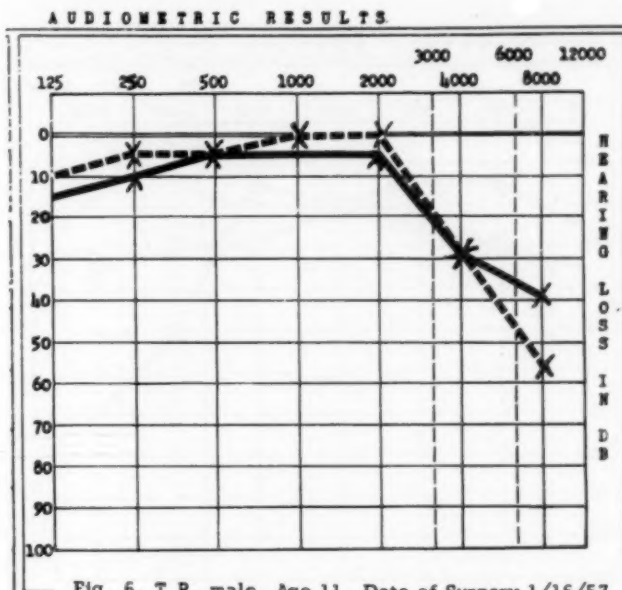


Fig. 6. T.R. male, Age 11, Date of Surgery 1/16/57.

the anterior attic recess were found and removed; the intact ossicles were left in place. Healing was complete in September, 1956. Post-operatively her hearing improved to a 25 db. level for the speech frequencies; there has been no evidence of recurrence of the cholesteatoma, and the patient will shortly undergo tympanoplasty (Audiogram, see Fig. 5).

Case 6.—T. R., Male, age 11, first seen in September, 1956, with a history of intermittent discharge from both ears for the past eight years; repeated antibiotic treatment had been unsuccessful; the adenoids had been twice removed. Examination showed central perforations of both tympanic membranes with a purulent discharge; the right ear responded to prolonged penicillin therapy (several courses of three to four weeks),

but the left ear continued draining; he was placed on sygmamycin therapy for two weeks without success.

X-rays of the left mastoid showed a disturbed pneumatization with lack of aeration; his hearing loss averaged 5 db. in this ear. On January 16, 1957, a left atticomastoidectomy was performed. Granulations were removed from the perilyabyrinthine area and the epitympanum. On March 25, the drain was permanently removed and the middle ear has remained dry since. A spontaneous closure of the perforation occurred in July. There still was a dry perforation of the opposite drum; this closed with trichloracetic acid applications. The hearing in both ears now shows no loss (Audiogram, see Fig. 6).

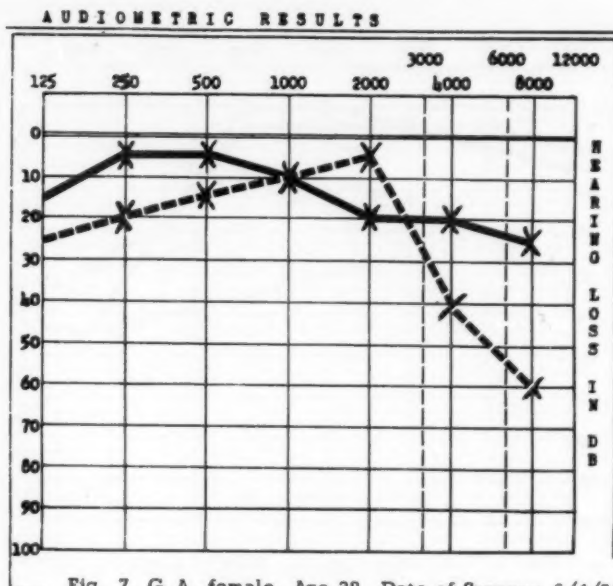


Fig. 7. G.A. female, Age 38, Date of Surgery 6/4/57.

Case 7.—G. A., Female, age 38, first seen in February, 1957, with a history of bilateral ear infection at the age of 3, followed by a chronic discharge from both ears and a right mastoidectomy at the age of 19. This resulted in complete healing of the right ear, but with a residual hearing loss of 40 db. The left ear had been draining intermittently, and the patient had been aware of a recent increase of hearing loss on that side. Examination showed a healed perforation of the right drum and a thick, injected tympanic membrane on the left side, with a small posterior central perforation and a mucopurulent discharge; the infection responded well to prolonged tetracycline therapy, but recurred shortly after cessation of the antibiotic.

X-rays of the left mastoid revealed patchy sclerosis with the exception of a few large clouded cells in the perisinus region; her hearing loss averaged 15 db. An atticomastoidectomy was performed June 4, 1957. Extensive granulations were found in the mastoid which was partially sclerosed; the few remaining cells contained a yellowish, tenacious mucus; the granulations extending into the attic were dissected from the intact ossicular chain. Our previously described postoperative care was given and in August the ear was dry; currently an attempt is being made to close the perforation with trichloroacetic acid applications and patching; her hearing loss is 5 db. (Audiogram, see Fig. 7).

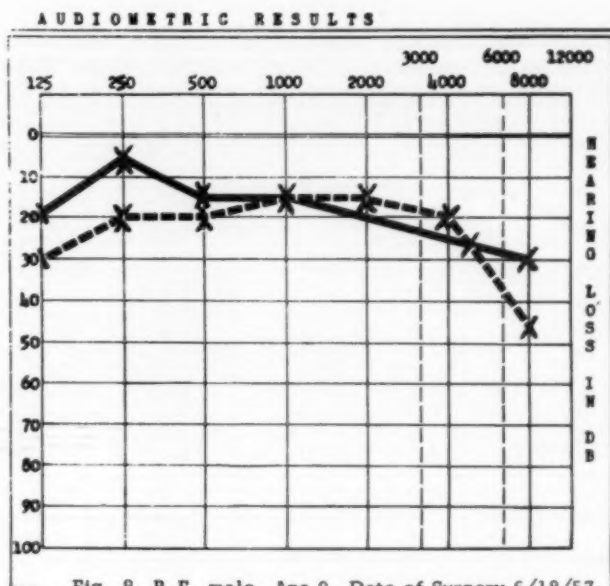


Fig. 8. R. F. male, Age 9, Date of Surgery 6/18/57.

Case 8.—R. F., Male, age 9, first seen in June, 1957, with a history of an infection of the left ear when he was 3 years old, resulting in a perforation with intermittent drainage; the discharge became profuse several weeks prior to this first visit, although the patient had been on daily penicillin therapy for three years because of an erroneous diagnosis of rheumatic fever; the doses of penicillin had been increased, and other antibiotics were added but failed to control the infection. Examination of the left ear revealed a purulent exudate from a central perforation of the tympanic membrane. The hearing loss averaged 15 db. in the speech range. X-rays of the mastoid revealed a large cavity, due to the confluence of several larger cells. The trabeculation in the periantral region was indistinct, with partial interruption and decalcification.

June 18, 1957, an atticomastoidectomy was performed. In the mastoid process a large confluent area of necrosis was found. The entire periantral, perilyabyrinthine areas and dural plate were necrotic and covered with granulations. After dissection and removal of the disease, the ossicular chain was found intact. In September, 1957, the ear was dry with a remaining central perforation; the hearing was comparable to the preoperative findings; the postoperative hearing loss in this ear averages 15 db. (Audiogram, see Fig. 8).

Case 9.—D. B., Male, age 10, first seen February 7, 1957, with a left acute subperiosteal mastoid abscess, temperature 101° F., and a discharg-

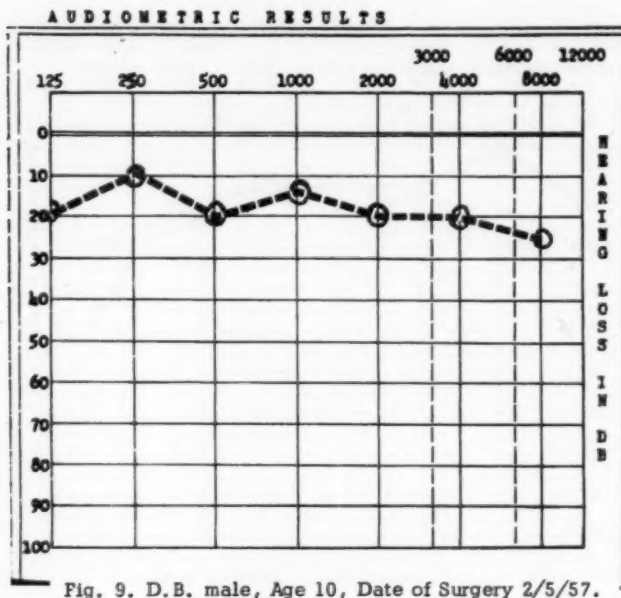


Fig. 9. D.B. male, Age 10, Date of Surgery 2/5/57.

ing left ear; no landmarks could be seen because of the swelling. His parents and the referring physician gave a history that one year prior to his present illness he had an acute ear infection treated with antibiotics, which resolved without perforation or drainage.

There was no intervening difficulty until two weeks prior to admission, when he developed pain in the left ear and a spontaneous discharge. He was immediately placed on penicillin therapy, and when this did not control the disease, terramycin, 750 mgms. daily, was added February 1, 1957. In spite of this treatment the patient developed a swelling over the left mastoid region on February 5, 1957, while on the combined antibiotic therapy.

X-rays showed some clouding of the mastoid with some coalescence of the trabeculae.

An atticomastoidectomy was performed on February 7, 1957. There was extensive breaking down of the mastoid cells, granulations covered the dural plate and a perisinus abscess was present; a cholesteatoma had eroded the lateral attic wall; the cholesteatoma matrix was completely removed under magnification; the intact ossicles and the remaining posterior superior canal wall were preserved; a polyethylene drain was placed in the antrum, and the incision was closed. The ear was dry in one month, and at the present the previously unseen posterior superior perforation is healed, and the hearing loss averaged 20 db. on December 20, 1957.

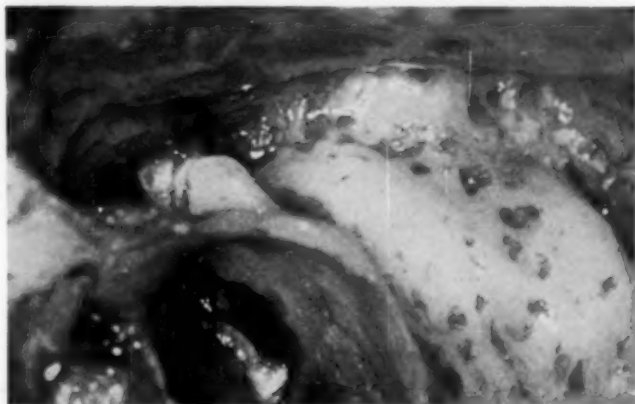


Fig. 10. Photograph of surgery, showing complete dissection of the anterior and the superior attic spaces and complete mastoidectomy. The ossicles have been dissected free of all granulation.

This case was included because along with Case V, a small anterior attic cholesteatoma was found and removed through the atticotomy approach; if a usual antrotomy had been performed the cholesteatoma would have been overlooked (Audiogram, see Fig. 9).

PATHOLOGY.

Gross: The usual findings are a dense cortex with patchy sclerosis in a previously pneumatized mastoid process. There are isolated areas of trabecular necrosis along with osteogenetic thickening in other areas. The areas most prone to bone necrosis are the perilabyrinthine cells and the dural plate, particularly in the area of the tegman antri, and attic.

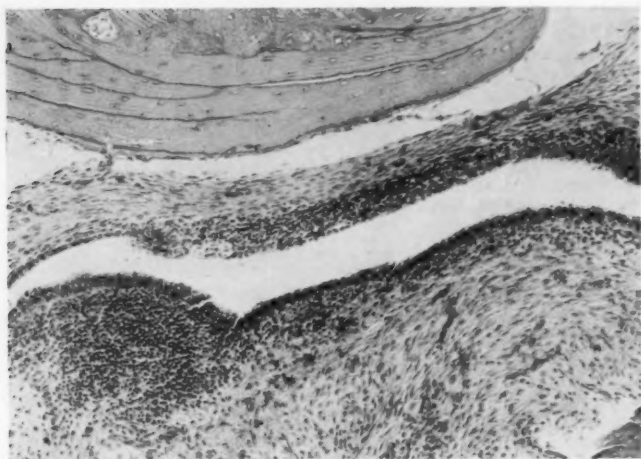


Fig. 11. Microscopic view of bone removed from mastoid showing new lamella being laid down in an area of osteogenesis adjacent to fibrotic granulation tissue with round cell infiltration.

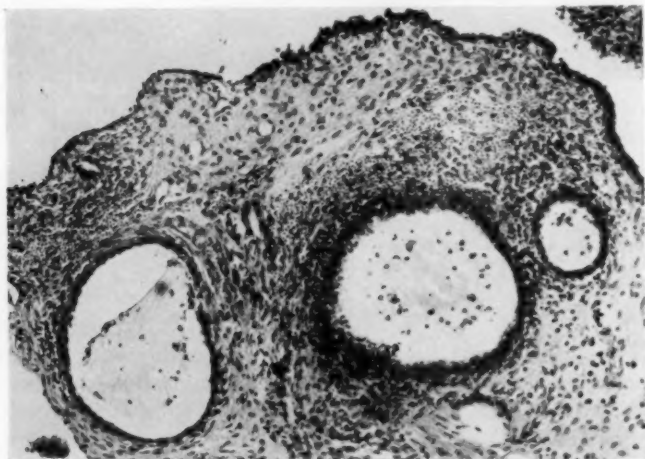


Fig. 12. Microscopic view of cystic spaces in granulation tissue removed at mastoid surgery.

Granulation tissue is present in the cellular remnants, in the antrum and about the ossicles. Unsuspected cholesteatoma was found in two cases. The ossicular chain is usually intact. The bacteriology has been omitted, because it was non-contributory.

Microscopic: The chronic mastoiditis usually exhibits a

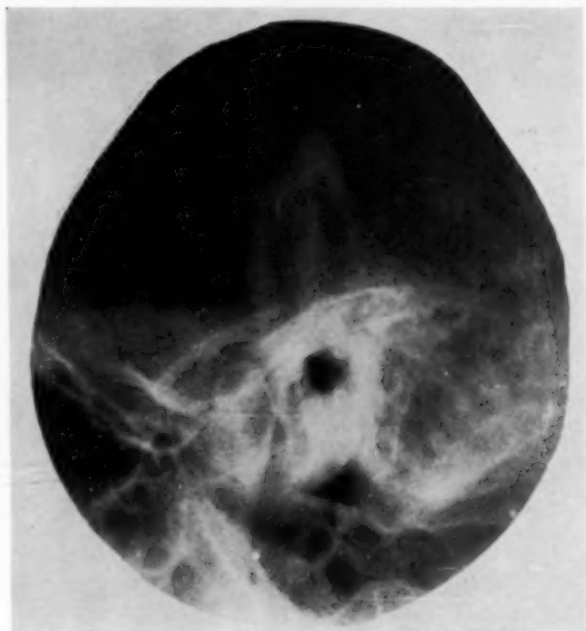


Fig. 13. X-ray of extensive mastoiditis in previously pneumatized cavity with extensive sclerosis beginning.

hyperplastic mucosa with extensive round cells infiltration, plasma cells and edema. The fibrosis is advanced in older cases. Cystic spaces occur with cholesterol crystals. Necrotic spicules of bone and empty lacunae with eroded cement lines are found in the more degenerative areas. There are evidences of new bone formation with parallel darkly stained cement lines and osteoblasts (see Figs. 11, 12).

X-RAY.

The mastoid was usually well developed on X-ray examination. Sclerosis, loss of individual contours of cells and cloudiness of antral and periantral regions was observed, and larger peripheral cells, which may have been the result of confluence were common. Their trabecular walls were markedly thick-



Fig. 14. X-ray of a more contracted mastoiditis with a small area of destruction over the sinus.

ened. Figs. 13, 14 and 15 are typical X-ray views of mastoid pathology which could benefit from this type of surgery.

SUMMARY AND RESULTS.

Nine cases of chronic suppurative otitis media, with central perforation, have been presented which did not respond to all current methods of nonsurgical therapy. In these patients the X-ray picture of the mastoid usually gives the impression

of a previously pneumatized mastoid with small areas of necrosis, lack of aeration and extensive sclerosis as a part of the co-existing process of bone disease and osteogenetic repair. This was confirmed by the pathology found at surgery. It demonstrated the irreversibility of the disease, and often more extensive infection and destruction than had been expected was encountered. This was particularly demonstrated in the attic along the dural plate and in the perilabyrinthine

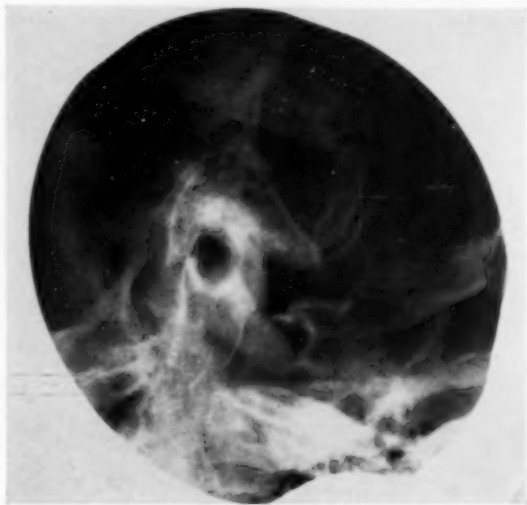


Fig. 15. X-ray of a chronic mastoiditis showing extensive destruction and confluence of cells in the entire posterior aspects of the mastoid.

spaces by areas of bone necrosis; also unsuspected cholesteatoma was found in two cases. Complete atticomastoidectomy without taking down the posterior or superior canal wall was performed. All cases so treated resulted in a complete resolution of the temporal bone suppuration. Most patients enjoyed a hearing improvement, often returning to the normal level of hearing. Closure of the tympanic perforation often occurs spontaneously. If the perforation is large it may be undertaken with tympanoplasty. In most cases it

has been our practice to delay closure of the drum by tympanoplasty because antibiotic dusting of the antral drain and middle ear is more efficient with an open drum membrane and also because postoperative closure can occur spontaneously, or be encouraged with trichloroacetic acid cauterization. We usually delay tympanoplastic closure until after the ear has demonstrated a prolonged period of healing and has not closed spontaneously.

CONCLUSIONS.

Atticomastoidectomy may be performed for chronic suppurative otitis media with central perforation of the tympanic membrane in appropriate cases with expectation of a cessation of discharge, resolution of the disease and restoration of normal or improved hearing.

SEVENTH INTERNATIONAL CONGRESS OF BRONCHESOPHAGOLOGY.

The Seventh International Congress of Bronchoesophagology will be held at Kyoto (Japan) University, September 12-14, 1958, under the direction of Prof. Mituharu Goto, M.D., Otorhinolaryngological Clinic, Kyoto University Hospital, Kyoto, Japan.

A registration fee of \$25.00 U.S.A. will be charged all physicians and a fee of \$10.00 for wives or non-medical guests. Registered members are admitted free to banquet, receptions and sightseeing tours.

STAPEDIO-VESTIBULAR OSTEOTOMY IN OTOSCLEROSIS.

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and

GILBERT CLAVERIE, M.D.,

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Stapes surgery has steadily improved since Rosen described his method for stapes mobilization in 1952. This operation is rational and fascinating, because it is essentially physiological. Despite this fact many otologists who have tried this surgery have been disappointed; in fact, the first reported statistics of the results showed only 40 per cent success. Several factors are responsible for the high incidence of failures obtained.

First, it is difficult to check thoroughly the extent of the pathology at the footplate of the stapes. It becomes even more difficult to perform the best surgical maneuvers suited for this particular type of footplate pathology. Manipulations often result in crural fractures rather than fractures in the articular interline itself. Occasionally the concomitant association of a complete closure of the round window by otosclerosis renders ineffective a successful stapes mobilization. In spite of these disadvantages many authors realize that the future of otosclerosis surgery lies in this type of operative approach, because it is rational and physiological.

Following "simple stapes mobilization" otologists began considering "stapes surgery," and even the concept of a "surgery of the labyrinthine window."¹ We mentioned in a previous report¹ the different procedures which we employ in the frame of this surgery according to the pathology encountered. We particularly emphasized the stapedo-vestibular osteotomy, which is the object of the present report. Its technical elements are as follows:

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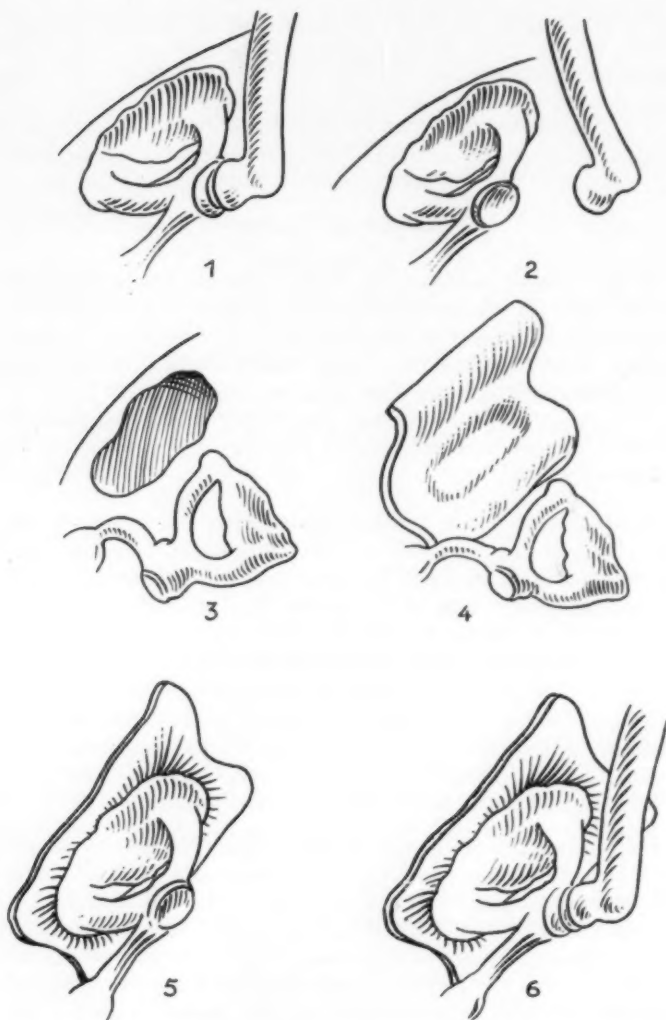


Fig. 1. 1—Stapes aspect before the operation; 2—Disarticulation of the incus; 3—Osteotomy and removal of the stapes; 4—Graft on the oval window; 5—The stapes is replaced in good position on the graft; 6—The incus is replaced on the stapes head.

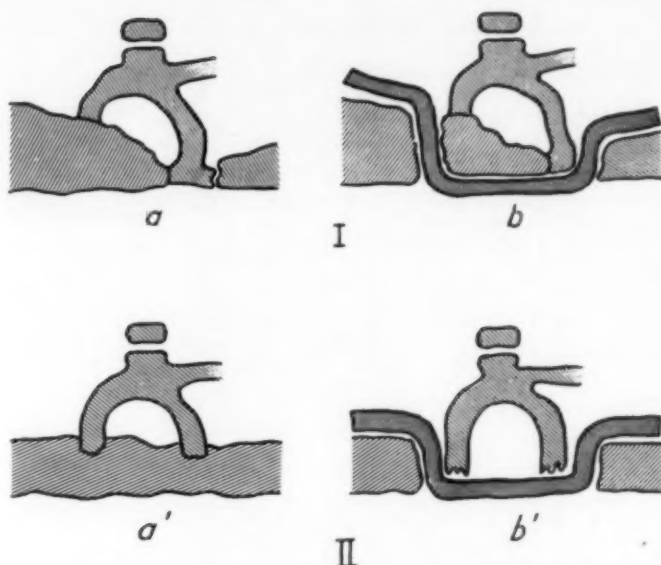


FIG. 2. Principle of the Osteotomy with Interposed Graft.—I. Osteotomy Type I—We can conserve the footplate; a. before the operation; b. after the operation.

II. Osteotomy Type II—We cannot conserve the footplate; a. before the operation; b. after the operation.

I. APPROACH.

The approach must be large so as to see the whole stapes with its footplate. The operation includes either the retro- and supra-auricular approach which is large,¹ or the transmeatal approach. When we employ the latter the phases are as follows:

First phase: (Incision).

An incision is made one-half centimeter from the sulcus tympanicus from one to six o'clock on the left, or eleven to six o'clock on the right posterior canal wall.

Second phase: (Elevating).

The tympanomeatal flap thus formed is elevated and displaced anteriorly.

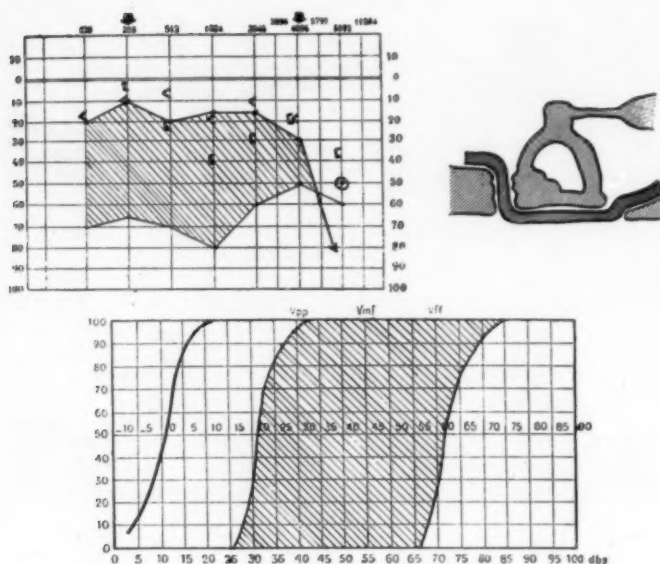


Fig. 3. An Example of the Functional Result Obtained by Osteotomy—Type I. Shaded part: the audiometric gain; [: bone conduction before; < : bone conduction after the operation. A bone conduction gain is also noted.

Third phase: (Corda Tympani).

The corda tympani nerve is isolated and displaced anteriorly. It can be cut if it is in the way.

Fourth phase: (Bone Resection).

Bony resection of the annulus is very important, in order to provide a good view of the whole stapes. We prefer to use a bur with a bent hand-piece for this phase.

Fifth phase: (Disarticulation of the Incus).

The incus is detached at the level of the stapes head and pulled to the front. It is replaced after the stapes phase.

II. PHASE OF STAPES SURGERY.

The pathology on the periphery of the stapes is analyzed with 16 magnifications or higher.

Schematically the various essential aspects are:

1. If it is beginning otosclerosis with a normal stapes and a visible articular interline a "simple mobilization" could be sufficient; however, it is always carried out by working on the footplate itself. Direct action on the neck or head must be given up, or at any rate should be used only to finish a

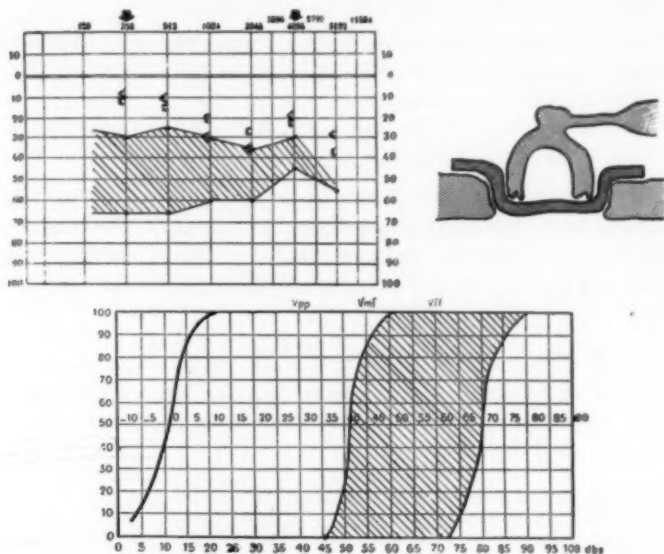


Fig. 4. An Example of the Result Given by an Osteotomy—Type II. Shaded part: the audiometric gain; [: bone conduction before the operation; < : bone conduction after the operation.

mobilization which has already been performed by maneuvers on the footplate.

2. If the osteome fills up a normal stapes because it presses against the crus, the osteotomy allows the removal of the part of the osteome which disturb the motion of the stapes.

If the osteome has overgrown the anterior part of the articular interline, according to Fowler Jr., you can do a

section of the anterior crus and the anterior part of the footplate to isolate the lesion. One can also make an osteotomy.

3. In many other cases the osteome is more extensive and occludes the articular line. We can then perform a stapedo-vestibular osteotomy.

4. Sometimes the lesion covers the entire stapes completely. In this case it is again possible to try an osteotomy and a "fenestration" in the area of the oval window.

We have then several methods of stapedio-vestibular osteotomy available according to the type of pathology.

Instruments.

We employ the following instruments:

Thin osteotomes: needles and fine hooks with a straight handle and also with a spoon-shaped handle. The shape of the latter (after the Zöllner idea) facilitates visibility but does not permit the rotary motion, which is possible only with a straight handle instrument.

A special microdrill, already described.²

Thin suction tubes permitting the washing with serum. This liquid with a composition similar to perilymph should be used at 37° centigrade.

Technique of the Simple Osteotomy.

With the thin osteotomes (needles) small holes are made in the expected zone of the articular interline. We must be careful not to crack the crura. When this maneuver is impossible, due to the thickness of the bone, we must have recourse to the microdrill. This permits the performing of microscopic labyrinthine trepanations like a dotted line crossing the lesion. It is then possible to fracture the bone between the holes and thus obtain mobilization. In some cases the pathology is very localized, generally in both the upper and anterior part, so that the osteotomy must be performed only in this area. Occasionally the footplate is atrophic, transparent and contrasts with the density of the anterior part. Then the action must be very gentle in order to avoid its fracture.

Technique of Osteotomy with Interposition.²

An objection could be made to the simple stapedo-vestibular osteotomy; in fact, the new interline obtained by the operation divides two pathological bony surfaces which are very active. It is, therefore, logical to think that after a few years both parts of the osteome will unite again. We tried to improve this osteotomy by the interposition of a tissue so as to prevent re-ankylosis. The graft to be applied on the oval window must be very thin. After various experiments we decided on the vein graft previously proposed by Shea, Jr., that is, a small section from a vein of the back of the hand cut open along its long axis. The connective tissue is thinned down. This graft constitutes an excellent material to apply on an oval window.

Type I: As soon as the osteotomy is performed the stapes is removed from its frame so that the oval window is open; however, the ossicle keeps one connection with the walls of the tympanum by its muscle tendon which is not cut off. It is turned over its tendon and pulled down so that it does not impede work on the oval window itself. The mucosa which surrounds the window is removed. The graft is then applied to the window with its adventicia toward the labyrinth and its endothelium toward the tympanum. Finally the stapes is replaced into its proper place in the window, but on the graft which is used as an interposition.

Type II: In certain cases the window is completely closed by a very thick and white bone from which the crura seem to emerge. It is not possible to create a footplate in such a lesion. We must then cut the crura near the osteome so that the stapes consists of only the head and crura. It is still attached to the stapedius tendon. The oval window is then cleared of otosclerotic bone. The graft is applied, endothelial side out, to the recreated oval window. The stapes is then replaced with the ends of the crura directly connected with the vein graft, which is used as a footplate.

III. CLOSURE OF THE OPERATIVE FIELD.

Bleeding must be avoided. After suction the necessary

microcoagulation is performed. The incus is put back in place on the head of the stapes. The corda tympani nerve is replaced and finally the tympanomeatal flap.

Post-operatively the patient may present a syndrome of labyrinthine irritation, sometimes severe, with nystagmus toward the side of the operation. The slightest motion of the head may provoke dizziness and nausea. This reaction disappears within a few days. Sometimes there is no reaction at all.

CONCLUSION.

These surgical procedures are still in the experimental stage. The excellent results which we have obtained with them indicate that they are an improvement in stapes surgery. The percentage of success for all stapes surgery is steadily increasing despite many persistent technical difficulties and as yet unestimated surgical risks. We believe that future technical progress will result in maximum results.

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AMERICAN BOARD OF OTOLARYNGOLOGY.

The American Board of Otolaryngology will conduct only one examination in 1958, and this will be October 6-9, 1958, in Chicago, Illinois, at the Palmer House.

For further information address Dr. Dean M. Lierle, Secy-Treas., University Hospital, Iowa City, Iowa.

UNILATERAL PARALYSIS OF VOCAL CORD
FOLLOWING ADMINISTRATION OF
TETANUS ANTITOXIN (TAT).*

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Any peripheral neuritis after administration of tetanus antitoxin (TAT) is very rare, if one considers the enormous number of persons treated with it. Involvement of the recurrent laryngeal nerve is even less frequent, but nevertheless it should be known that it may occur. Bearing this in mind may be helpful in establishing the correct diagnosis of unilateral vocal cord paralysis of "unknown" origin. The prognosis is uniformly good and no specific treatment needed. Incidentally ACTH and Cortisone have been tried without any significant acceleration of recovery.

The etiology and pathology of this entity were well discussed in previous papers,^{1,4,10,11,12} and the reader is referred there for details. Involvement of the recurrent laryngeal nerve probably follows the same pattern as in other peripheral nerves, *i.e.* edema of the nerve due to impaired blood supply, which causes temporary damage to the nerve and impairs its function. The damage to other peripheral nerves, especially those of brachial plexus, may be permanent, and certain authors assess the incidence as high as 20 per cent.^{4,12} In both of our cases, in spite of good and relatively fast functional recovery, there remained some sluggishness in movements of both vocal cords and arytenoids even six months after the onset of the paralysis. One year later, however, both cases showed normal function.

It is generally stated that neuritic complications after TAT appear about one week after its application.⁴ This was true in our second patient, who had a paralysis of the left vocal

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cord as a single complication after TAT administration. The first patient, a case of severe tetanus infection, had a right brachial plexus involvement with paralysis of right vocal cord which was discovered in the fourth week of hospitalization. Here, however, TAT was given both prophylactically and later on, therapeutically, in high doses, so that it was hard to decide which one of these separate doses of TAT was the cause of paralysis.

REPORT OF TWO CASES.

Case 1: P. R., 18 years old, white male, admitted on September 2, 1952, with chief complaint of stiffness of neck and pain in throat and shoulders of 16 hours' duration. One week prior to the admission the patient fell down, cutting his right forearm on a dirty rock. The wound was sutured by a local physician, a prophylactic dose of TAT was given and the patient started on penicillin twice a day. Two days prior to the admission the wound became infected, and several sutures were removed by the local physician. The following day the patient began to feel stiffness in his neck and throat and was running temperature. On admission there was stiffness of neck, pain on motion of neck, shoulders and upper back muscles. Trismus was pronounced, making the examination of the larynx impossible. There was, however, no hoarseness and no respiratory distress. Laceration 6 cm. long on the right lower forearm was infected and partially closed with three sutures. The wound was opened, cultures and smears taken which eventually grew *Clostridium tetani*; debridement and treatment with irrigations and soaks were carried out. Patient received 200,000 units of TAT, 60,000 of which were injected around the wound and 140,000 i.m. In spite of heavy sedation he had frequent attacks of opisthotonic spasms and required tracheotomy on the second day for laryngospasm. After a severe and rather stormy course he improved after three weeks, and tracheotomy tube was removed on the twenty-first postoperative day. Toward the end of the fourth week of hospitalization it was discovered that he was hoarse, and indirect laryngoscopy showed a paralyzed right vocal cord. At the same time he developed weakness of right shoulder, forearm and wrist. He was improving quickly without any specific therapy, and three months later his voice was normal and only some sluggishness of the movements of the right cord and right arytenoid still persisted. Last check on April 29, 1954, showed a perfectly normal function of both cords.

Case 2: F. L., 43 years old, white male, was seen at E.N.T. Clinic on June 9, 1953, with a chief complaint of hoarseness of seven weeks' duration. Indirect laryngoscopy revealed a paralysis of left vocal cord with minimal movements of left arytenoid. His history was essentially negative except that he was given "a tetanus shot" by his local physician for puncture wound of his foot. One week following the injection he suddenly became dyspneic and hoarse. Dyspnea disappeared soon, but hoarseness persisted. Patient was referred to Speech Clinic for speech therapy and improved very much in one month. When seen at E.N.T. Clinic one year later his left vocal cord showed normal function.

SUMMARY AND CONCLUSIONS.

Two cases of paralysis of the recurrent laryngeal nerve

are reported where the cause apparently was the reaction to TAT. The first case developed unilateral paralysis of the vocal cord after therapeutical dose of 200,000 units of TAT after having received a prophylactic dose one week before therapy was started. In this case there was an associated involvement of right brachial plexus. The second case developed unilateral paralysis after prophylactic dose of TAT, and this was the only complication present.

Both cases improved functionally *ad integrum* within six months without any specific therapy. The second case received speech therapy, which we believe was helpful to overcome faster the acute period of voice impairment and helped him in social readjustment.

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DIFFERENCE LIMEN OF INTENSITY IN HEARING IMPAIRMENT DUE TO CRANIOCEREBRAL INJURY.*

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Auditory damage in connection with craniocerebral injury is due to labyrinth concussion, which damages the organ of Corti. This has been confirmed by both experimental studies (Schuknecht²⁰) and by clinical observations (Drooker,⁶ Grove⁹). According to the severity of the blow, the end-organ damage consists of loss of the external hair cells, loss of the external and internal hair cells, or complete disappearance of the organ of Corti (Schuknecht²⁰).

In Ménière's disease, recruitment is a constant finding. This is also the case in end-organ deafness caused by acoustic trauma. In retrolabyrinthine hearing disorders, on the other hand, recruitment does not exist (Day,⁴ Dix,⁵ Eby and Williams,⁷ Reger and Kos¹⁸). Even though the difference limen and recruitment phenomena are not exactly identical, they are, however, based on related physiological backgrounds (Fowler,⁸ Hirsh,¹⁰ Lund-Iversen,¹⁴ Tonndorf²¹); therefore, in cases with recruitment, a reduced difference limen for intensity has been observed and vice versa (Békésy,¹ Lundborg,¹³ Lüscher,¹⁶ Jerger¹²).

As the hearing loss following head injury, is due to end-organ damage, one might suppose that the recruitment phenomenon and a reduced difference limen should be characteristic for it; however, clinical observations show that patients with concussion of the labyrinth after severe head trauma do not respond uniformly. Both cases with decreased difference limen and recruitment, as well as cases with normal difference limen and without recruitment have been seen (Lüscher,¹⁶ Saltzman¹⁹).

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MATERIAL.

The difference limen in hearing impairment due to cranio-cerebral trauma was investigated by means of Békésy¹ audiograms in a series of 43 war veterans. In this series were included all cases with a hearing loss of at least 30 db. in one or more frequency ranges. The age of the patients varied from 30 to 50 years, being 37 years on an average. The investigation was carried out on an average of 12 years after injury. In every case a detailed neurologic investigation was undertaken, and in a detailed psychologic investigation, special attention was given to signs of impaired perception and attention capacities. In each case, the subjective troubles caused by the hearing impairment were also noted. In the symptomatology, the symptoms of cerebral injury dominated, the hearing impairment being of secondary importance. In 30 cases the primary injury had been a local cranial trauma due to high-speed missiles, generally shrapnel and bullets. In the other 13 cases the primary injury had been a cranio-cerebral concussion.

In analogy with Lundborg,¹³ the Békésy¹ audiograms were grouped in four types according to the amplitude of the difference limen. Type IV represents a strongly reduced difference limen; Type III a partially reduced one; Type II, a tendency to a reduced difference limen, and Type I, a normal difference limen. In addition to this, patients with a difference limen higher than 20 db. at some frequency ranges formed an extra group of a high difference limen (Lüscher¹⁶).

RESULTS.

In one single case the Békésy¹ audiogram represented Type IV. This was a case of temporal injury. The hearing was impaired, and the reduced difference limen was present in the ear opposite the site of injury. This finding is not at all in accordance with the pattern of hearing impairment seen in temporal injuries (Hormia¹¹). Indeed, in the light of other clinical findings, this case could be diagnosed as morbus Ménière, independent of the trauma.

In four cases the Békésy¹ audiograms represented the Type III, and all belonged to the group of local injuries.

In eight cases the Békésy¹ audiograms represented Type II. From these, five were local injuries and three concussions.

In nine cases, the Békésy¹ audiograms represented Type I, with a normal difference limen. Of these, three were local (right temporal) injuries, and six were concussions.

In 23 cases the difference limen was higher than normal. From these, 19 were local injuries (with a total of seven

TABLE I.

The correlations between the amplitude of difference limen in Békésy audiogram and the hemisphere of the craniocerebral injury, the effectiveness of perception and attention capacities, and the subjective inconvenience of the hearing impairment.

	Hemisphere of the Head Injury		Perception and Attention		Hearing Impairment Subjectively	
	left	right	impaired	others	not disturb.	disturb.
Cases with High Difference Limen	15	8	10	13	17	6
Other Cases	8	12	5	15	9	11

parietal) and four were concussions. In two cases the difference limen decreased somewhat in higher frequency ranges (These cases are, therefore, included also in the group of Type II). The highest average difference limens seen in this series were 30-35 db.

Checking the factors which could be significant of a high difference limen, it was seen that in these cases the following factors were more common than in the other cases (see Table I):

The primary injury was located on the side of left hemisphere.

As a consequence of the brain injury, the perception and attention capacities were greatly deteriorated.

The hearing impairment was subjectively not disturbing for the patient.

Regarding no one of these factors could the results be shown to be statistically significant because of the small number of cases. The significance of these three factors may be seen more clearly by examining their total effect. From the 23 cases with a high difference limen eight had less than two of the three factors mentioned above, in 15 cases two or three of the factors were present. In the series of the other 20 cases the numbers were 15 and five. This shows a clear difference between the group of cases with a high difference limen and the other group (Statistically significant, $\frac{x}{\sigma}=2.62$).

DISCUSSION.

In the light of the material presented above, it is obvious that a reduced difference limen is not characteristic for the hearing impairment in connection with craniocerebral injuries, yet the mechanism of the hearing impairment is one of labyrinth concussion and it thus is a question of end-organ deafness. This result does not agree with the prevailing opinion that a reduced difference limen and recruitment are typical of labyrinth deafness.

Some investigators have explained the recruitment phenomenon as due to reaction of the more intact inner hair cells in cases with damaged outer hair cells (Lurie,¹⁵ Meyer zum Gottesberg¹⁷). The inner hair cells lie directly against the bone; thus, it is reasonable to assume that in cases with severe head injury the concussion effect which reaches the labyrinth through the bones of the skull also damages the inner hair cells. There can even be a secondary degeneration of the peripheral cochlear neuron (Schuknecht²⁰). Compared with the mechanism of acoustic trauma (Bernabei²) and the increased endolymphatic pressure mechanism of the hearing impairment in Ménière's disease (Cawthorne and Hewlett³), it seems possible that in cases of blows to the head the inner hair cells receive relatively more damage, even though these are not so easily injured as the more sensitive outer hair cells.

The explanation of the absence of reduced difference limen

in cases with deafness due to head trauma may be found in a more uniform damage of the organ of Corti with its nerve supply.

A high difference limen was seen in one-half of the cases. Lüscher¹⁰ has expressed the significance of psychic factors for the occurrence of high difference limen. This observation was confirmed in the material presented above. High difference limen was seen especially in cases where the cerebral injury was on the side of the dominating hemisphere and had caused a deterioration of the perception and attention capacities. It was also seen that the subjective inconveniences of the hearing impairment for these patients were of less degree than for the others. This can be understood as a sign of a deterioration, especially of those areas of perception and attention functions which are closely connected with auditive sensations (Hormia¹¹). These findings show that the psychic factors causing high difference limen can be due to organic brain damage.

SUMMARY.

The difference limen in hearing impairment caused by craniocerebral injury was studied with the Békésy audiograms in a series of 43 war veterans. In only four cases could a partly reduced difference limen be seen. As a possible explanation for the absence of reduced difference limen, the mechanism of the hearing impairment in connection with head blows was considered. It is a question of end-organ deafness due to concussion of the labyrinth. This concussion wave reaches the labyrinth through the bones; therefore, the inner hair cells are more prone to the damage and a more uniform damage of the organ of Corti results than in those types of end-organ deafness characterized by a reduced difference limen and presence of recruitment.

A high difference limen was seen in one-half of the cases. In these cases signs of deteriorated (auditive) perception and attention capacities were noted. The result thus confirms the significance of psychic factors upon the incidence of a high difference limen.

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Assistant Secretary-Treasurer: Dr. Jacob E. Reisch, Springfield, Ill.

NETHERLANDS SOCIETY OF OTO-RHINO-LARYNGOLOGY.
(Nederlandsche Keel-Neus-Oorheelkundige Vereniging.)

President: Dr. H. Navis, Sonsbeekweg 6, Arnhem.
Secretary: Dr. W. H. Struben, J. J. Viottastraat 1, Amsterdam.
Treasurer: Mrs. F. Velleman-Pinto, Jac. Obrechtstr. 66, Amsterdam.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY.

President: Dr. J. C. Peele, Kinston Clinic, Kinston, N. C.
Vice-President: Dr. George E. Bradord, Winston-Salem, N. C.
Secretary-Treasurer: Dr. J. D. Stratton, 1012 Kings Drive, Charlotte 7,
N. C.
Meeting:

NORTH OF ENGLAND OTOLARYNGOLOGICAL SOCIETY.

President: Mr. G. L. Thompson, 16 Ramshill Road, Scarborough, Yorkshire.
Vice-President: Mr. J. H. Otty, Frizley Old Hall, Frizinghall Road, Bradford, Yorkshire.
Secretary and Treasurer: Mr. R. Thomas, 27 High Petergate, York, Yorkshire.

OTOSCLEROSIS STUDY GROUP.

President: Dr. Joseph A. Sullivan, 174 St. George St., Toronto 5, Canada.
Secretary-Treasurer: Dr. Arthur L. Juers, 611 Brown Bldg., Louisville, Ky.
Meeting: Palmer House, Chicago, Ill.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY.

President: H. Leroy Goss, M.D., 620 Cobb Bldg., Seattle 1, Washington.
Secretary-Treasurer: Homer E. Smith, M.D., 508 East South Temple, Salt Lake City, Utah.
Meeting:

PAN AMERICAN ASSOCIATION OF OTO-RHINO-LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY.

President: Dr. Jose Gros, Havana, Cuba.
Executive Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40, Pa., U. S. A.
Meeting: Sixth Pan American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Time and Place: Brazil, 1958.

PHILADELPHIA LARYNGOLOGICAL SOCIETY.

President: Dr. Chevalier L. Jackson.
Vice-President: Dr. John J. O'Keefe.
Treasurer: Dr. Joseph P. Atkins.
Secretary: Dr. Louis E. Silcox.
Historian: Dr. Herman B. Cohen.
Executive Committee: Dr. Harry P. Schenck, Dr.; Benjamin H. Shuster, Dr. William A. Lell, Dr.; William J. Hitschler.

PORTUGUESE OTORHINOLARYNGOLOGICAL SOCIETY.

President: Dr. Albert Luis de Mendonca.
Secretary: Dr. Antonio da Costa Quinta, Avenida, de Liberdade 65, 1^a Lisbon.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Clifton E. Benson, Bremerton, Wash.
President-Elect: Dr. Carl D. F. Jensen, Seattle, Wash.
Secretary: Dr. Willard F. Goff, 1215 Fourth Ave., Seattle, Wash.

RESEARCH STUDY CLUB OF LOS ANGELES, INC.

Chairman: Dr. Orrie E. Ghrist, 210 N. Central Ave., Glendale, Calif.
Treasurer: Dr. Norman Jesberg, 500 So. Lucas Ave., Los Angeles 17, Calif.
Otolaryngology: Dr. Russell M. Decker, 65 N. Madison Ave., Pasadena 1, Calif.
Ophthalmology: Dr. Warren A. Wilson, 1930 Wilshire Blvd., Los Angeles 57, Calif.
Mid-Winter Clinical Convention annually, the last two weeks in January at Los Angeles, Calif.

SECTION OF OTOLARYNGOLOGY OF THE MEDICAL SOCIETY OF THE DISTRICT OF COLUMBIA.

Chairman: Dr. J. L. Levine.
Vice-Chairman: Dr. Russell Page.
Secretary: Dr. James J. McFarland.
Treasurer: Dr. Edward M. O'Brien.
Meetings are held the second Tuesday of September, November, January, March and May, at 6:30 P.M.
Place: Army and Navy Club, Washington, D. C.

SCOTTISH OTOLARYNGOLOGICAL SOCIETY.

President: E. A. M. Connal, 1 Royal Crescent, Glasgow C. 3, Scotland.
Secretary-Treasurer: Dr. J. F. Birrell, 14 Moray Place, Edinburgh.
Assistant Secretary: Dr. H. D. Brown Kelly, 11 Sandyford Place, Glasgow.

SOCIEDAD COLUMBIANA DE OFTALMOLOGIA Y OTORRINOLARINGOLOGIA (BOGOTA, COLUMBIA).

Presidente: Dr. Alfonso Tribin P.
Secretario: Dr. Felix E. Lozano.
Tesorero: Dr. Mario Armas A.

SOCIEDAD CUBANA DE OTO-LARINGOLOGIA.

President: Dr. Reinaldo de Villiers.
Vice-President: Dr. Jorge de Cárdenas.
Secretary: Dr. Pablo Hernandez.

SOCIEDAD DE ESTUDIOS CLINICOS DE LA HABANA.

Presidente: Dr. Frank Canosa Lorenzo.
Vice-Presidente: Dr. Julio Sanguily.
Secretario: Dr. Juan Portuondo de Castro.
Tesorero: Dr. Luis Ortega Verdes.

SOCIEDAD DE OTORRINOLARINGOLOGIA Y BRONCOESOFAGOSCOPIA DE CORDOBA.

Presidente: Dr. Aldo Remorino.
Vice-Presidente: Dr. Luis E. Olsen.
Secretario: Dr. Eugenio Romero Diaz.
Tesorero: Dr. Juan Manuel Pradales.
Vocales: Dr. Osvaldo Suárez, Dr. Nondier Asis R., Dr. Jorge Bergallo Yofre.

**SOCIEDAD DE OTO-RINO-LARINGOLOGIA,
COLEGIO MEDIO DE EL SALVADOR, SAN SALVADOR, C. A.**

President: Dr. Salvador Mixco Pinto.
Secretary: Dr. Daniel Alfredo Alfaro.
Treasurer: Dr. Antonio Pineda M.

SOCIEDAD ESPANOLA DE OTORRINOLARINGOLOGIA.

Presidente: Dr. D. Adolfo Hinojar Pons.
Vice-Presidente: Dr. D. Jose Perez Mateos.
Secretario General: Dr. D. Francisco Marañés.
Tesorero: Dr. D. Ernesto Alonso Ferrer.

SOCIEDAD MEXICANA DE OTORRINOLARINGOLOGIA

Havre 7—Desp. 62
Mexico 6, D. F.

Honorary President: Dr. Ricardo Tapia y Fernández.
President: Dr. Máximo García Castañeda.
Secretary: Dr. Eduardo de la Parra.
Treasurer: Dr. Guillermo Pérez Villasante.
Vocal: Dr. Rafael Pachiano.

SOCIEDAD NACIONAL DE CIRUGIA OF CUBA.

Presidente: Dr. Reinaldo de Villers.
Vice-Presidente: Dr. César Cabrera Calderín.
Secretario: Dr. José Xirau.
Tesorero: Dr. Alfredo M. Petit.
Vocal: Dr. José Gross.
Vocal: Dr. Pedro Hernández Gonzalo.

**SOCIEDAD OTO-RINO-LARINGOLOGIA DE LOS
HOSPITALES DE MADRID.**

Presidente: Dr. Don Fernando Beltrán Castillo.
Secretario General: Dr. Don Alfonso Vassallo de Mumbert.
Tesorero: Dr. Don Rafael García Tapia.

SOCIEDAD VENEZOLANA DE OTORRINOLARINGOLOGIA.

Presidente: Dr. Alfredo Celis Pérez.
Vice-Presidente: Dr. Bustamante Miranda.
Secretario General: Dr. Jesús Miralles.
Tesorero: Dr. M. Matheus.
Vocales: Dr. Perez Velasquez and Dr. Wilmer Palacios.

**SOCIEDADE DE OFTALMOLOGIA E OTORRINOLARINGOLOGIA DO
RIO GRANDE DO SUL.**

President: Dr. Paulo Fernando Esteves.
Vice-President: Dr. Jayme Schilling.
First Secretary: Dr. Carlos Buede.
Second Secretary: Dr. Moisés Sabani.
First Treasurer: Dr. Israel Scherman.
Second Treasurer: Dr. Rivadávia C. Meyer.
Librarian: Dr. Carlos M. Carrion.

SOCIEDAD PANAMENA DE OTORRINOLARINGOLOGIA

Presidente: Dr. Manuel Preciado.
First Vice-Presidente: Dr. Alonso Roy.
Second Vice-Presidente: Dr. Carlos Arango Carbone.
Secretario: Dr. Maria Esther Villalaz.
Tesorero: Dr. Ramon Crespo.

SOCIEDADE PORTUGUESA DE OTORRINOLARINGOLOGIA E DE BRONCO-ESOFAGOLOGIA.

Presidente: Dr. Alberto Luis De Mendonca.
Vice-Presidente: Dr. Jaime de Magalhaes.
1.º Secretario: Dr. Antonio da Costa Quinta.
2.º Secretario: Dr. Albano Coelho.
Tesoureiro: Dr. Jose Antonio de Campos Henriques.
Vogais: Dr. Teofilo Esquivel.
Dr. Antonio Cancela de Amorim.
Sede: Avenida da Liberdade, 65, 1º, Lisboa.

SOCIETY OF MILITARY OTOLARYNGOLOGISTS.

President: Capt. William C. Livingood, U.S.N. (M.C.)
Secretary-Treasurer: Lt. Col. Sanley H. Bear, M.C., 3810th USAF Hospital, Maxwell AFB, Alabama.
Meeting: Palmer House, Chicago, Ill.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. James H. Gressette, Orangeburg, S. C.
Vice-President: Dr. Robert P. Jeanes, Easley, S. C.
Secretary-Treasurer: Dr. Roderick Macdonald, 333 East Main St., Rock Hill, S. Car.
Meeting:

SOUTHERN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY.

Chairman: Dr. V. Eugene Holcombe, Charleston, W. Va.
Chairman-Elect: Dr. G. Slaughter Fitz-Hugh, Charlottesville, Va.
Vice-Chairman: Dr. George M. Haik, New Orleans, La.
Secretary: Dr. Mercer G. Lynch, New Orleans, La.

VIRGINIA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. Benjamin Sheppard, 301 Medical Arts Building, Richmond, Virginia.
President-Elect: Dr. Emanuel U. Wallerstein, Professional Building, Richmond, Virginia.
Vice-President: Dr. Calvin T. Burton, Medical Arts Building, Roanoke, Virginia.
Secretary-Treasurer: Dr. Maynard P. Smith, 600 Professional Building, Richmond, Virginia.
Meeting:

WEST VIRGINIA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY.

President: Dr. James K. Stewart, Wheeling, W. Va.
Secretary-Treasurer: Dr. Frederick C. Reel, Charleston, W. Va.
Annual Meeting: Greenbrier, White Sulphur Springs, W. Va., May 31st through June 1st.

